U. S. DEPARTMENT OF AGRICULTURE

AGRICULTURAL RESEARCH SERVICE

ANIMAL HUSBANDRY RESEARCH DIVISION

and

COOPERATING WESTERN STATES

W-1 - IMPROVEMENT OF BEEF CATTLE THROUGH THE APPLICATION OF BREEDING METHODS

1962 Annual Report of W-1

and

Report of

Annual Meeting of Technical Committee

Fort Collins, Colorado

July 12-13, 1962

This report is intended for the use of administrative leaders and workers and is NOT for general publication.

Animal Husbandry Research Division
Beef Cattle Breeding Research
312-B New Custom House
Denver 2, Colorado

Annual Report of W-1

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Annual Meeting of Technical Committee

Colorado State University

Fort Collins, Colorado

July 12 and 13, 1962

PROGRAM

Dr. C. C. O'Mary, Chairman

July 12

8:00 A.M.	Introductory Remarks	Dr. C. C. O'Mary
8:10 A.M.	Welcome to Colorado State University Director, Agricultural Experiment Station	Dr. S. S. Wheeler
8:20 A.M.	Results of Fertility Testing College of Veterinary Medicine	Dr. E. J. Carroll
9:15 A.M.	Pilot Studies with Small Animals Animal Industry Department	Dr. L. H. Haverland
9:45 A.M.	Station Reports	
10:45 A.M.	Tour of Bull Farm and Animal Science Building and review work of Dr. David A. Cramer on chromatographs on animal fats	
12:00 Noon	Lunch	
1:00 P.M.	Station Reports	
4:00 P.M.	Report of Objectives Study Committee	Dr. Ralph Bogart
	Report on Regional Publication	Dr. R. T. Clark
	Report on Literature Review	Dr. C. B. Roubicek
	Report on Statistical Service	Dr. J. S. Brinks

Dr. G. E. Nelms, Chairman

July 13

8:00 A.M.	Expanded Use of Sires for Genetic-Environmental Interaction and Top Cross Tests	Dr. H. H. Stonaker
8:20 A.M.	Project Revisions	
12:00 Noon	Lunch	
1:00 P.M.	Remarks	
	Chief, Beef Cattle Research Branch	Dr. E. J. Warwick
	Principal Animal Geneticist, Cooperative State Experiment Station Service	Dr. M. J. Burris
	Regional Administrative Adviser	Dr. S. S. Wheeler
	Business Meeting Election of Chairman Time and Place of 1963 Meeting	
	Adjourn	

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ANNUAL MEETING
W-1 Technical Committee
Colorado State University
Fort Collins, Colorado
July 12 - 13, 1962

Clayton C. O'Mary, Chairman

Project Leaders Present

Arizona	O. F. Pahnish
California	P. W. Gregory
Colorado	H. H. Stonaker
Hawaii	Estel H. Cobb
Idaho	R. E. Christian
Montana	F. S. Willson
Nevada	C. M. Bailey
New Mexico	L. A. Holland
Oregon	Ralph Bogart
Utah	J. A. Bennett
Washington	C. C. O'Mary
Wyoming	G. E. Nelms
U. S. Range Livestock Experiment Station	N. M. Kieffer
Regional Administrative Adviser	S. S. Wheeler
Western Regional Coordinator	R. T. Clark
Geneticist	J. S. Brinks
Agricultural Research Service	
Beef Cattle Research Branch, AHRD	E. J. Warwick
Cooperative State Experiment Station Service	M. J. Burris

The Chairman, Dr. O'Mary, called the meeting to order at 8:00 A.M. July 12, 1962. He thanked Dr. Stonaker and the administration of Colorado State University for inviting the W-1 Technical Committee to meet at that institution.

Dr. Wheeler welcomed the group to Colorado State University campus and described the changes that were taking place in added facilities and new programs of research in the field of biology and related sciences. He referred to the problems involved in bringing about integration of old and new programs.

He mentioned the interest shown by all Directors in the subject of a regional publication, the printing of which has been agreed to by the Oregon station based upon the firm orders received from other cooperating stations.

He referred to the achievements of W-1 to date and complimented the W-1 Technical Committee on the conduct of the project.

Dr. E. J. Carroll of the College of Veterinary Medicine presented the results of fertility testing, and since Dr. T. M. Sutherland of Colorado State University could not attend the meeting, the work he has been doing with mice was reviewed by Dr. Loren Haverland.

EVALUATION OF BULLS FOR BREEDING SOUNDNESS

E. J. Carroll

I. Introduction

The beef industry is subject to considerable economic loss each year because of breeding failure.

Baker and Quesenberry[1] reported conception rates varying from 45.5% to 93.9% in single sire herds at the Miles City Station. Their findings have shown the importance of quickly identifying the poor breeding bull and eliminating him from the herd. They believed it would be of value to test bulls for semen quality before the breeding period in order to eliminate the partially sterile bulls.

The acceptance of the concept of "herd infertility" has become increasingly noticeable during recent years. While individual females may suffer sporadic, non-transmissible infertility, their effect on the breeding efficiency of the herd is insignificant when compared with a subfertile male. There is an increasing demand being placed upon the veterinary profession for an accurate and critical estimate of the breeding potential of range bulls.

Lagerlof[2] has offered a simple classification of male infertility which has three divisions:

1. Complete absence of sexual desire
2. Incapacity to copulate
3. Incapacity to fertilize

The first two forms are obvious and are relatively simple to evaluate. Incapacity to fertilize represents the most important form of infertility and is the most difficult to evaluate accurately using methods that are within the realm of practical application under field conditions.

A great number of tests have been described that attempt to correlate conception rate in artificial insemination with the various physical criteria of semen. Measures of the functional or metabolic activity of the sperm cell have been reported as the most accurate means of predicting fertility. The facilities and time required for these procedures renders them impractical for routine use in the field.

A method for evaluating semen based on arbitrary numerical values for the gradations of observable physical characteristics has been developed at Colorado State University.[3] The standards are a compilation of research and the experiences of many well-known authorities covering a period in excess of thirty years. This scoring system has been put to widespread use over the past seven years. More than eight thousand bulls have been evaluated by Colorado State University.

II. Method of Semen Collection

The artificial vagina is accepted as the preferred method of semen collection. Bulls collected in this manner will deliver semen of the quality and quantity that the individual is potentially capable of producing more consistently and with less inconvenience. The value of the technique is limited under certain situations:

1. Bulls that refuse to serve a tease animal.
2. Crippled animals.
3. Animals not accustomed to being handled by halter, such as range beef bulls.

The development of the electronic ejaculator was a critical factor in making the evaluation of range bulls a feasible management practice. Hill and co-workers[4] demonstrated that there is no appreciable difference in volume, concentration, percent alive and motility of semen samples collected with the artificial vagina as compared with electro-ejaculator.

Most beef ranches have adequate facilities to restrain bulls for electro-ejaculation. Under these field conditions it has been possible for a veterinarian to perform a complete examination on 25 to 30 bulls in a working day.

Most of the bulls examined by the Colorado State University Bull Evaluation Service have been collected by electro-ejaculation. The artificial vagina was used in circumstances when it was indicated and favorable conditions for use available.

The major disadvantage of the electro-ejaculator is that it does not provide any measure of the animal's desire to perform in natural service.

III. Evaluation of Semen Quality

The physical characteristics of semen usually considered are: volume, color, pH, concentration, motility and per cent alive. There are many reports in the literature dealing with individual characteristics and their correlation with fertility. In the work at Colorado State University an attempt has been made to consider the major characteristics (concentration, motility, per cent alive and morphology) in combination to arrive at a final classification.

A. Concentration or Density of Spermatozoa

According to Lagerlof [2] the concentration of spermatozoa in fertile bulls varied from 300 million to 2 billion per cc, with an average of 8 million. Haq [5] concluded that spermatozoan density is within normal limits in many bulls with testicular degeneration and that, therefore, other tests are usually necessary for an accurate evaluation of semen quality. He indicated that concentration of spermatozoa should be looked upon with suspicion before a final decision. Blom [6] reported that in 24 bulls with serious affections of the testes, 13 had a concentration less than 200,000 per cmm. Blom [7] also showed that in two cases of experimentally induced testicular degeneration spermatozoan concentration fell simultaneously with an increase in the number of primary sperm cell abnormalities. Another characteristic of sperm cell concentration noted in many infertile or sterile bulls is a rapid decrease between first, second and third successive ejaculates, indicating poor spermatozoan reserves and reduced sperm cell concentration.

This criterion is subject to variation due to techniques and method of collection, psychic influence at time of ejaculation and physical status of the bull. In the scoring system, this factor received 20% of the total value. The technique used for determining concentration is gross observation of the sample based on its appearance in the collection vial. It has been shown that this is accurate in estimating cell counts within a 250 million cell range of error.

The table below describes the grades of concentration.

CONCENTRATION

Grade	Count (million/cc)	Appearance
VG	750 & UP	Creamy, white, flake-like appearance, viscid
G	400-750	White, but more bluish, no flakes
F	250-400	Milky color, transulucent, pours freely
P	Less than 250	Watery, grey color, pours like water.

B. Degree of Vigor or Motility

The motility of spermatozoa is commonly used as a measure of the fertilizing ability of sperm. Blom reported that 92% of 100 normal bulls had satisfactory motility [6] whereas only 32% of the "problem" bulls had satisfactory motility. Although motility in fertile bulls is higher than in infertile bulls, the decrease in motility does not parallel the decrease in fertility. Certain cases of acquired sterility show very good motility. It is quite generally concluded in the literature that an estimate of motility, in conjunction with other semen tests, is of definite value in the diagnosis of infertility; considered alone, it is of doubtful value.

Degree of vigor, or rate of motility, received the greatest weight in scoring system - 40%. It is determined by visual microscopic examination and assigned relative values of very good, good, fair or poor.

MOTILITY

Grade	Appearance
VG	Vigorous swirls and eddies
G	Slow swirls and eddies
F	No wave motion but some cells showing movement
P	Slow laborious progression of a few cells

C. Morphology of Spermatozoa

It is generally agreed that the appreciable numbers of abnormal cells are undesirable and nearly always associated with varying degrees of infertility. The morphology classification utilized is patterned after the interpretation described by Blom.[8] Primary sperm abnormalities are assumed to be due to disorders in the spermatogenic epithelium. Secondary abnormalities are the result of some unphysiologic condition(s) affecting the cells after they have passed through the efferent ductuli. "Spheriod" is the term used to designate the spherical, heavily granulated, often multi-nucleate cells of varying size found in high numbers in testicular degeneration associated primarily with atrophic changes in the seminiferous tubules. Their significance has been arbitrarily grouped with primary abnormalities. The following table illustrates the morphology grades.

MORPHOLOGY

Grade	Primary	Secondary
VG	Less than 10%	Less than 20%
G	" " 20%	" " 35%
F	" " 30%	" " 50%
P	More than 30%	More than 50%

D. Per Cent Live Cells

This criterion is determined by the eosin-nigrosin staining technique described by Blom.[6] It has been observed that this is a more accurate evaluation than attempting to estimate "per cent motility" in a fresh preparation, especially when work performed by other than an experienced laboratory technician. The grade for the various per cent alive is given in the following table:

PERCENT ALIVE

Grade	
VG	More than 70%
G	50% to 70%
F	30% to 50%
P	Less than 30%

E. Method of Scoring the Semen Sample

The relative values assigned to the criteria used in grading bull semen are given in the accompanying table. If the total score is less than 60, subsequent ejaculates are evaluated until it surpasses that level or a lower level is definitely established. Bulls are then classified as satisfactory, questionable or unsatisfactory breeders in regard to semen quality. The minimum total score for the satisfactory and questionable classifications is 60 and 30 respectively. Numerous case histories of individual bulls presented to Colorado State University Bull Testing Service lend considerable support to the accuracy of this scoring system. However, there is also record of discrepancy in some instances.

	Score			
Grade	Motility	Morphology	Concentration	% Alive
VG	40	30	20	10
G	24	18	12	6
F	8	8	9	2
P	3	3	7	1

Satisfactory - 60 and up
Questionable - 30 to 60
Unsatisfactory - Less than 30

IV. Physical Examination

All animals were examined for physical defects that could interfere with the ability to copulate. Particular attention was given to the reproductive system (penis, testicles, accessory glands), eyes and locomotor system. Details of the physical examination were incorporated into final classification given to the animal.

The animals were not routinely examined for venereal disease. There were many cases that were subjected to diagnostic procedures for venereal disease; this information is not included in this summary.

V. Method of Summarizing Observations

All records of examination were transferred to IBM punch cards. All recorded examinations were used; there are data missing from some of the examinations, especially during the first two years work. Many bulls were examined more than one time; this summary includes only the results of the first examination.

Processing of the data is still in progress; this constitutes a preliminary report.

VII. Summary

The results of examining 7651 beef bulls have been presented.

1. When both semen quality and physical characteristics are considered, 80.8% of the animals were classed as satisfactory prospective breeders.
2. There is a marked increase in the number of satisfactory bulls from one to two years of age; the per cent of satisfactory bulls is comparable from two through six years. The relative number of satisfactory bulls begins to decline at seven years of age with a marked drop in the group ten years and older.
3. When considering the major physical characteristics of semen - concentration, vigor (motility), morphology and per cent alive - there is a higher correlation between final classification and morphology than any other criterion.
4. Only 0.57% of the bulls studied failed to ejaculate when stimulated with the electro-ejaculator.

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5. Haq, I. Causes of Sterility in Bulls in Southern England. Brit. Vet. Jour. 105, 3-6, 71, 114, 143, 200. 1949.

6. Blom, Erik. 1950 Thesis: "Methods of Evaluating Bull Semen" (Trans. C. Mortensen) State Veterinary Serum Laboratory, Copenhagen V, Denmark.

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REPORT ON SMALL ANIMAL BREEDING RESEARCH

T. M. Sutherland*
Conducted by Animal Science Department, Colorado State University

CONSEQUENCES OF SELECTION FOR RAPID GAIN IN MAMMALS

This investigation of the effects of selection in mice for high rate of gain is now seven generations beyond the foundation populations. Substantial and gratifying progress has been made in securing additional facilities for the mouse colony.

There was little or no response in rate of gain until generation four. From generation three to generation six, total gain on test increased approximately 25% for both sexes. Averages for the control line remained within the ranges of previous levels. Feed consumption has remained at similar levels for all lines. There is some evidence of a divergence in feed consumption between the selected and control lines. This shows up especially in the new data now plotted for generation six. There has been a downward trend in feed requirement per gram of gain in all lines. The reason for the behavior of the control line in this respect is not known. The trend was more rapid for the selected lines than for the control line through generation. Beyond generation four, the selected and control lines have tended to converge in efficiency. The reason for the apparent convergence is not known. There is a trend toward lower weaning weight in two of the selected lines. This trend is shared with the control line. Average weaning weight for one of the selected lines remains at the level of the foundation populations. There is a marked consistancy, though not complete, in the behavior of the sexes for the various traits. Some special studies are being made with the heaviest mice in the selected lines. Juvenile hair loss, resulting in partial nakedness of the mouse between three and five weeks of age, has been observed in some of the lines and is also being studied.

*Presented by L. H. Haverland

I. Station: Arizona Agricultural Experiment Station, Tucson, Arizona

II. Project Title: Breeding and selection of beef cattle for the Southwest

III. Personnel:

Experiment Station:

O. F. Pahnish, leader, L. W. Dewhirst, W. H. Hale, F. E. Hubbert, Jr., A. M. Lane, C. B. Roubicek, E. B. Stanley, B. R. Taylor, and R. E. Taylor

Graduate Students:

T. A. Anderson, E. K. Keating, W. T. Hayer, R. L. Roberson, E. L. Russell, and R. L. Taylor

Cooperators:

Empire Ranch, Sonoita, Arizona
Arivaca Ranch, Arivaca, Arizona
Apache Indian Agency and Apache Tribe, San Carlos, Arizona

Montana Agricultural Experiment Station, Bozeman, Montana
Wyoming Agricultural Experiment Station, Laramie, Wyoming
U. S. Range Livestock Experiment Station, Miles City, Montana

U. S. Department of Agriculture, Agricultural Research Service:

R. T. Clark, Coordinator

IV. Nature and Extent of Work Done This Year:

Empire and Arivaca Ranches

Processing of the entire block of data was continued as time permitted. Since data collection on the Empire and Arivaca ranches has terminated, emphasis during the past year was on processing of data from the Apache Tribal Herd. The latter project is still active, and evaluation of these data is of primary importance.

Part of the results obtained from the Empire and Arivaca study were published.

Apache Tribal Herd

Collection of data as described in the project plan was continued. An additional bull from Miles City Line 1 was obtained from the Havre

Branch station in Montana for progeny test. This bull is being used during the 1962 breeding season. Data for an evaluation of mothering ability of topcross females (progeny of bulls from Miles City Lines 1, 6, 9, and 10 × unrelated cows in the Apache Tribal Herd) are being collected. To extend the evaluation of the Miles City lines, topcross bulls (progeny of bulls from Miles City Lines 1, 6, 9 × unrelated cows in the Apache Tribal Herd) were bred back to the cows in the Tribal Herd in 1961 and 1962.

Chemical analyses of blood samples were kept current.

Results of the preliminary study of serum protein fractions were published.

Studies of growth data on three calf crops were reported or prepared in manuscript form.

Evaluations of Miles City sires and lines on the basis of three calf crops were continued. The results are summarized in this report.

V. Summary of Progress and Conclusions to Date:

Results of the statistical analyses of weaning and fall yearling growth data, conformation scores, and condition scores on progeny of Miles City sires used in the Apache Tribal Herd were summarized in the 1961 annual report. Results of similar analyses of data collected at about 345 days of age (near the end of first winter after weaning) are summarized in tables 1, 1A, and 2. Over-all evaluations of topcross progeny by sire lines as represented by the sires used are presented in tables 3 and 3A.

All animals available at each successive sampling period were used in the analyses of weaning data (226 days of age), data collected at 345 days of age, and data collected at fall yearling age (590 days).

Growth data and scores at 345 days of age (tables 1, 1A, and 2).

Years had important effects on all bull traits studied and on all heifer traits except change in grade (345-day grade minus weaning grade; table 1).

Age of dam affected daily gain of bulls and heifers from weaning age to 345 days of age, the condition of bulls at 345 days of age, and the change in grade and condition of heifers from weaning age to 345 days of age (table 1). For the nature of the age-of-dam effects, see table 2.

Sires had important effects on changes in condition from weaning time to 345 days of age, on the condition of bulls at 345 days of age, and on the daily gain of bulls from weaning to 345 days of age (table 1).

Differences in age at time of weighing had important effects on 345-day weights, and on the daily gain of bulls from weaning time to 345 days of

age. The latter is the only case in which evidence of a significant age effect on gain has been noted in the evaluations of growth data from this herd (table 1).

All traits studied to date, if significantly affected by sires, were listed in table 1A. Here, the lack of uniformity among progeny groups by sires within Miles City lines may be seen. A lack of uniformity among progenies of the other 8 sires used also is evident. Seven of the latter 8 sires were produced in the Apache Tribal Herd. Important differences among sires compared across Miles City lines were noted for each trait listed in table 1A. Differences in the weaning weights of calves by Line 1 sires reflect the deviations of the weaning weights of the sires themselves from the line-within-year means at Miles City. Direct comparisons of sire performance and progeny performance were not possible for traits other than weaning weight.

Evaluations of sire lines (table 3 and 3A).

With the progeny of the 8 sires of other than Miles City origin as a control group, progeny of Line 1 and Line 9 sires averaged above the control group in both weaning weight and fall yearling weight (tables 3 and 3A). Line 1 and Line 9 progenies averaged slightly lower than the control group in weaning grade but they compared favorably with the control in fall yearling grade. Line 6 and Line 10 progenies averaged below the control in weaning weight, and generally below the control in fall yearling weight. These line progenies showed no consistent advantage in weaning and fall yearling grade.

If emphasis is placed on the production of feeders to be marketed at weaning or fall yearling age, this study suggests that Line 1 and Line 9 breeding may be preferable to Line 6 and Line 10 breeding under conditions such as those involved in this study.

Differences between Line 1 and Line 9 progenies were noted (tables 3 and 3A). The Line 9 calves were slightly heavier at weaning time, graded higher, and were significantly higher in condition. During the winter period from weaning to 345 days of age, when gains were generally negative, the Line 1 progeny lost less weight, weighed heavier at 345 days of age, and gained enough thereafter to weigh heavier at fall yearling age. Line 9 progeny again scored somewhat higher in condition, and graded higher at fall yearling age.

While temperament was not specifically rated, the progeny of Line 9 sires were observed to be of excellent disposition and were exceptionally easy to handle. The progeny of Line 6 sires were poorest in this respect.

The progeny of all Miles City sires were compared with the progeny of all other sires tested (tables 3 and 3A). The progeny of the Miles City

sires were significantly lower in weaning condition. The heifer progeny of the Miles City sires lost significantly less condition during the first winter after weaning. All other differences between the progenies of these two major groups were nonsignificant.

Age-of-dam effects on growth from birth to fall yearling age (table 4).

Age-of-dam effects on bull weights and gains at all ages studied were consistently greater than the effects on heifer weights and gains. The same was true of age-of-dam effects on the weaning weights of calves on the Empire and Arivaca Ranches (Pahnish, et al. 1958. Amer. Soc. Anim. Prod. West. Sect. Proc. 9:XLVIII-1).

Age-of-dam effects on 345-day weights were statistically nonsignificant but in the same direction as the effects on weaning weight. These effects on fall yearling weights of bull calves were important, and the effects on both bull and heifer weights were again in the same direction as at weaning time. Similar age-of-dam effects on fall yearling weights were reported by Koch and Clark in 1955 (J. Animal Sci. 14:386).

Age-of-dam effects on daily gains from weaning age (226 days) to 345 days of age were significant. The reversed direction of these effects reduced the age-of-dam effects on 345-day weights. The age-of-dam effects on gains beyond 345 days of age were again in the original direction. While they were statistically nonsignificant, these effects on gains of bulls after 345 days of age were of sufficient magnitude to make age-of-dam effects on fall yearling weights of considerable importance. These age-of-dam effects on postweaning gains were similar in nature to those observed in feedlot cattle by Swiger in 1961 (J. Animal Sci. 20:183).

PROGENY TESTS ON FIRST-CALF HEIFERS[1]

Arizona Agricultural Experiment Station

1960 calves

Sires	Dams	N	Weaning weight	Weaning grade
SC	L1 topcross	11	548	11.3
SC	L6 topcross	8	574	11.5
SC	L9 topcross	20	540	11.6
SC	SC	5	505	11.0
SC	All topcrosses	39	550	11.5
1961 calves				
SC and L9 topcross	L1 topcross	7	465	11.8
"	L6 topcross	12	485	11.0
"	L9 topcross	8	478	11.0
"	SC	26	462	10.9
"	All topcrosses	27	478	11.2
SC	L1 topcross	5	462	12.2
SC	L6 topcross	9	476	11.2
SC	L9 topcross	5	467	11.2
SC	SC	16	449	10.9
L9 topcross	L1 topcross	2	472	11.0
"	L6 topcross	3	512	10.3
"	L9 topcross	3	498	10.7
"	SC	10	482	11.0
SC	All topcross	19	470	11.5
L9 topcross	All topcrosses	8	496	10.6

[1]Weights adjusted to 240 days of age, bull calf basis and mature dam basis

Table 1.
Variance analysis of data collected at 345 days of age (animals dropped from 1957 through 1959)[1]

Variable	D.F.	Mean squares: 345-day weight	Da. gain wean. to 345 days	Grade 345 days	Cond. 345 days	Grade change 345-day weaning	Cond. change 345-day weaning
				BULLS			
Year	2	117,724**	8.0016**	30.69**	36.60**	6.42**	2.80**
Age of dam	2	13,000	.1324*	1.32	.96*	.56	.27
Sire	16	3,584	.1539**	.57	.56*	1.33	1.13*
Age of animal	1	118,478**	.2355**	1.22	.62	1.06	.05
Error	215	5,130	.0295	.49	.31	.79	.65
				HEIFERS			
Year	2	12,866**	4.8930**	27.14**	4.96**	1.24·	11.14**
Age of dam	2	711	.1024*	.28	.02	4.14**	1.98**
Sire	16	2,579	.0293	.78	.64	.37	.80**
Age of animal	1	93,523**	.0331	1.87	1.35	.02	.24
Error	219	1,534	.0259	.56	.44	.82	.15

[1] Total of 237 bulls and 241 heifers
**P < .01 *P < .05

Table 1A.--Multiple range tests where sire effects were significant in original variance analyses

Traits		Among sires within Miles City lines[1]	Among sires across Miles City lines[2]	Among other sires[2]
Weaning weight		L1	S	S
Daily gain birth to wean.		NS	S	S
Weaning grade		NS	S	S
Daily gain wean. to 345-days	(M)	L1 & L9	S	S
	(F)	-nonsignificant sire effect-		
345-day condition	(M)	L6	S	NS
	(F)	-nonsignificant sire effect-		
345-day condition	(M)	L9	S	S
Weaning condition	(F)	L1 & L9	S	S
Fall yearling weight	(M)	L1	S	S
	(F)	NS	S	NS
Daily gain, 345 days to fall yearling age	(M)	L1	S	S
	(F)	NS	S	NS

[1] L1, L9, etc. indicate lines in which differences among sires were significant (P < .05).

[2] S indicates significance (P < .05). NS is nonsignificant (P < .05).

Table 2.--General means and constants from least squares analyses of 345-day data

Means and constants	Miles City line	Years sires represented	N		345-day weight		Daily gain weaning to 345 days		Grade 345 days[1]		Condition 345 days		Grade change 345 days - weaning		Cond. change 345 days - weaning	
			Bulls	Heifers	Bulls	Heifers	Bulls	Heifers	Bulls	Heifers	Bulls	Heifers	Bulls	Heifers	Bulls	Heifers
General means[2]			237	241	437	420	-.17	-.09	9.5	9.7	8.7	8.6	-1.2	-1.3	-1.7	-2.1
									CONSTANTS[3]							
Year of birth:																
1957			65	68	-57	-17	.41	.39	.0	.2	-.3	.1	.6	.2	.4	.4
1958			90	87	54	18	.13	-.04	.7	.5	.9	.2	-.2	.0	-.1	-.5
1959			82	86	2	-1	-.53	-.35	-.7	-.7	-.6	-.3	-.4	-.2	-.2	.1
Age of dam:																
3,4	11 yrs.		88	94	-13	-3	.03	.03	-.1	.0	-.1	.0	.0	.3	.1	.2
5	10 yrs.		56	50	0	-1	.01	.01	.0	-.1	.0	.0	.1	-.2	.0	.0
6 -	9 yrs.		93	97	13	3	-.05	-.04	.1	.1	.1	.0	-.1	-.1	.0	-.1
Sires:																
1	1	57	11	9	60	23	.16	.00	.0	.0	.0	.1	.0	-.1	.2	-.1
2	1	57-59	28	28	0	-7	-.02	.03	-.2	-.3	-.2	-.2	.0	.0	.1	.3
15	1	59	9	5	-8	36	.10	.13	-.2	.3	.0	.2	.2	.2	.1	.5
3	6	57-59	21	28	14	-17	.09	-.05	.5	.1	.4	.1	.4	-.2	.2	.1
4	6	57-59	28	25	-15	-20	.01	.00	-.1	-.3	-.1	-.1	-.2	.0	.1	.2
5	9	57-59	21	31	2	0	-.17	.00	.0	.1	-.1	.2	-.1	.0	-.5	.2
6	9	57-59	21	23	-2	3	.03	-.07	.1	-.2	.0	-.3	.3	-.2	.1	-.2
16	10	59	4	8	-12	-1	-.07	.05	.1	-.1	.0	-.1	-.5	-.1	-.4	.2
17	10	59	8	6	-32	-5	.10	-.07	-.3	-.2	-.2	-.3	.4	-.1	.1	.1
7		57	8	4	19	3	-.05	-.09	.0	.5	-.3	.5	-.8	-.2	-.7	-.6
8		57	2	3	24	32	-.06	-.07	-.1	-.7	.0	-.5	-.5	-.5	.3	-.9
9		57	7	2	21	31	-.30	.14	-.2	.4	-.1	.2	-.6	.9	-.5	-.4
10		58	10	7	-19	-19	.00	.06	.2	.4	.3	.4	.1	.0	.1	.2
11		58-59	16	17	-30	-11	-.12	.01	-.2	-.2	-.1	-.3	-.2	-.2	-.2	-.2
12		58-59	17	14	-11	-8	.13	.03	.1	.1	.0	.3	.4	.0	.1	.0
13		58-59	19	24	-5	-25	.04	-.04	.1	.0	.3	-.1	.3	.2	.3	.1
14		59	7	7	-6	-15	.11	-.04	.3	.0	.3	.1	.8	.1	.5	.5
Age of animal					1.381	1.134	-.0019	-.0007	.0044	.0051	.0032	.0043	.0041	.0005	-.0009	.0018

[1]Based on feeder grades. Low Choice is 10. High, and Middle Good values are 9 and 8, respectively.
[2]Estimates of means at 345 days of age
[3]Constants expressed as deviations from the mean

Table 3.--Evaluations of lines and comparisons of all Miles City sires vs. all other sires (bull progeny only)

	Da.gain birth to weaning	Weaning wt.	Da.gain wean.to 345 da.	345 day wt.	Da.gain 345-da.to fall yrlg.	Fall yrlg. wt.	Weaning Grade	Weaning Cond.	345-day Grade	345-day Cond.	345-day - weaning Grade	345-day - weaning Cond.	Fall yrlg. Grade	Fall yrlg. Cond.
General Mean (μ)[1]	1.66	459	-.17	437	1.31	756	10.63	10.37	9.47	8.67	-1.20	-1.67	10.21	9.97
					MEANS AS DEVIATIONS FROM GENERAL MEANS									
Line 1	.01	6	.08	17	.11	39	-.19	-.26	-.12	-.11	.08	.15	-.10	-.02
Line 6	-.02	-8	.05	-1	-.02	-12	.10	-.01	.17	.14	.11	.15	.10	-.05
Line 9	.05	11	-.07	0	.04	13	.03	.05	.00	-.06	.13	0.19	.26	.38
Line 10	-.05	-11	.01	-22	-.08	-45	-.21	-.21	-.11	-.10	-.06	-.19	-.16	-.12
All MC sires	-.002	0.3	.03	1	.02	3	-.08	-.13	-.02	-.04	.06	.01	.01	.04
All other sires	.002	-0.4	-.03	-1	-.03	-3	.09	.14	.03	.05	-.07	-.01	-.01	-.04
					ORTHOGONAL CONTRASTS									
M.C. vs. other	NS	NS	NS	NS	NS	NS	NS	*	NS	NS	NS	NS	NS	NS
High vs. low line														
1 vs. 9			**											
1 vs. 10				NS	**	**								
6 vs. 1									NS	NS				
6 vs. 9												*		
6 vs. 10							NS							
9 vs. 1								*						
9 vs. 10	*	*									NS		NS	NS

[1]General means from least squares analyses. Daily gain birth to weaning, weaning weight, and weaning grade and condition scores were analyzed with sexes combined. These general means are adjusted for sex. Orthogonal contrasts for these four traits were from the data with sexes combined. All other analyses were within sex.

** P <.01 * P <.05 NS, P ≥.05

Table 3A.--Evaluations of lines and comparisons of all Miles City sires vs. all other sires (heifer progeny only)

	Da.gain birth to weaning	Wean-ing wt.	Da.gain wean.to 345 da.	345 day wt.	Da.gain 345-da.to fall yrlg.	Fall yrlg. wt.	Weaning		345-day		345-day - weaning		Fall yrlg.	
General mean (μ)[1]	1.54	427	-.09	420	1.33	749	Grade 10.95	Cond. 10.63	Grade 9.68	Cond. 8.61	Grade -1.25	Cond. -2.06	Grade 11.10	Cond. 10.99
MEANS AS DEVIATIONS FROM GENERAL MEANS														
Line 1	.01	6	.05	17	.01	25	-.19	-.26	.02	.04	.02	.25	.00	-.10
Line 6	-.02	-8	-.03	-18	-.05	-29	.10	-.01	-.10	-.03	-.09	.13	-.10	-.15
Line 9	.05	11	-.04	2	.05	11	.03	.05	-.04	-.05	-.09	-.03	.23	-.01
Line 10	-.05	-11	-.01	-3	.04	5	-.21	-.21	-.17	-.19	-.06	.12	.02	.18
All M.C. sires	-.002	0.3	.002	1	.01	6	-.08	-.13	-.06	-.05	-.05	.13	.03	-.03
All other sires	.002	-0.4	-.002	-1	-.01	-6	.09	.14	.07	.05	.05	-.15	-.04	.03
ORTHOGONAL CONTRASTS														
M.C. vs. other	NS	NS	NS	NS	NS	NS	NS	*	NS	NS	NS	**	NS	NS
High vs. low line														
1 vs. 6				**		**					NS			
1 vs. 9			*									**		
1 vs. 10									NS	NS				
6 vs. 10							NS							
9 vs. 1								*						
9 vs. 6					**								NS	
9 vs. 10	*	*												
10 vs. 6														NS

[1] General means from least squares analyses. Daily gains birth to weaning, weaning weight, and weaning grade and condition scores were analyzed with sexes combined. These general means are adjusted for sex. Orthogonal contrasts for these four traits were from the data with sexes combined. All other analyses were within sex.

** P <.01 * P <.05 NS, P >.05

Table 4.--Age of dam effects on weights and gains

	Da. gain birth to weaning	Wean. wt.	Da. gain wean. to 345 days	345-day wt.	Da. Gain 345 days to fall yrlg.	Fall yrlg. wt.
				BULLS		
Age-of-dam class:	**	**	*	NS	NS	**
3,4,11 yrs.	-.06	-14	.03	-13	-.02	-17
5,10 yrs.	.00	0	.01	0	-.01	- 2
6 - 9 yrs.	.05	14	-.05	+13	.03	20
				HEIFERS		
Age-of-dam class	**	**	*	NS	NS	NS
3,4,11 yrs.	-.02	- 8	.03	- 3	-.01	- 3
5,10 yrs.	.00	0	.01	- 1	.00	- 2
6 - 9 yrs.	.03	6	-.04	3	.01	5

[1]Effects expressed as deviations from least squares means. Daily gains birth to weaning and weaning weight analyzed with sexes combined. Sex X age-of-dam interaction constants used to obtain age-of-dam effects within sex. All other analyses were within sex.

** $P < .01$ * $P < .05$ NS, nonsignificant

VI. Application of Findings:

The data reported herein will contribute to the evaluation of the topcrossing merit of existing inbred lines of beef cattle.

Differences in the performance of Line 1 and Line 9 topcross progeny suggest that a cross of these two lines may have merit. The Line 1 progeny were growthy, while the Line 9 progeny were more moderate in growthiness, graded slightly higher, put on condition on range feed a little more readily, and were of excellent disposition.

Information concerning the growth curves of Southwestern range cattle up to fall yearling age was obtained, and the effects of environmental variables on growth, feeder grade, and condition were evaluated. This information will be useful in formulating beef cattle selection practices.

VII. Work Planned for the Future:

Empire and Arivaca Ranches

Analyses of the entire block of data will be completed.

Apache Tribal Herd

Correlations among the traits discussed in this report will be computed and heritability estimates will be obtained.

The evaluation of the mothering ability of topcross females will be continued.

Topcross bulls of Line 1, 6, and 9 breeding will be performance tested. Emphasis will be placed on tests of topcross bulls tracing to Lines 1 and 9. Use of the Line 6 breeding will be very limited. There will be no perpetuation of the Line 10 breeding, as data on an additional calf crop indicate that this breeding will contribute little to the experimental herd or to the existing program.

Additional progeny tests will be run on sires obtainable from any promising herd.

VIII. Publications and Manuscripts:

Pahnish, O. F., J. S. Brinks, R. T. Clark, and J. R. Quesenberry 1961. Range performance of progeny of Miles City sires. (Abs. 33.) J. Anim. Sci. 20(4):909.

Pahnish, O. F., C. B. Roubicek, and Farris Hubbert, Jr.
1961. Influence of sex, sire, and environmental factors on protein fractions in the blood serum of range calves. Amer. Soc. Anim. Prod. West. Sect. Proc. 12:VII-1-6.

Pahnish, O. F., E. B. Stanley, Ralph Bogart, and C. B. Roubicek
1961. Influence of sex and sire on weaning weights of Southwestern range calves. J. Anim. Sci. 20(3):454.

Pahnish, O. F.
1962. Some observations on range cattle performance. West. Livestock J.

Pahnish, O. F., R. L. Roberson, R. L. Taylor, C. B. Roubicek, R. T. Clark, and J. R. Quesenberry
1962. Postweaning performance of progeny of Miles City sires. Amer. Soc. Anim. Prod. West. Sect. Proc. 13:XXI

IX. PROJECT SUMMARY

Arizona Agricultural Experiment Station

Cattle Inventory

Purebred

Breed	Hereford
Line	Apache
Station	Arizona
Bulls 12 mos. or over	100
Cows 2 yrs. or over	525
Heifers, yearling	114
Bull calves	144
Heifer calves	149
Percentage used for breeding project[1]	-
Estimated cash value	$265,000

Grade None

[1]Cooperative project. No accurate method of determining percentage used in breeding project.

Cow Production Data — 1961 Calf crop

Breed	Hereford			
Line	Apache			
Cows bred to calve as 2-year-olds	--			
Cows bred to calve at 3 years and up	324			
Calves born from 3 year olds and up				
Alive	271			
Dead	11			
Total	282			
Calves weaned	257			
Percent calf crop[1]				
Birth	84			
Weaning	80			
	Bulls		Heifers	
	No.	Av.	No.	Av.
Birth weight	131	77	140	76
Weaning age		244		251
Weaning weight	125	469	132	463
Adjusted weaning weight[2]		457		430
Weaning score				
Condition-conformation	125	10.8	132	11.5

[1]Calving percentage based on calves weighed at weaning time and cows in herd during calving season.

Weaning percentage based on calves weighed at weaning time and cows in herd during calving season, less cows sold before weaning with calves at sice.

[2]Weights adjusted to 230 days of age and to a mature dam basis

[3]Score based on feeder grade. Scores of 10, 11, 12 are low, middle, and high choice, respectively.

Land, Physical Facilities, and Equipment Used

		Actual cash value	Used for breeding project
Apache Reservation			
Land	35 sections	$560,000	
Fencing	60 miles	29,400	
Corrals and scales		4,000	
Water supply		16,000	
Total		$609,400	
Experiment Station			
Laboratory facilities		$25,000	25%

UNIVERSITY OF CALIFORNIA

I. Station: California Agricultural Experiment Station, Davis, California

II. Project Title: Genetic control of hereditary deficiencies in beef cattle with special emphasis upon dwarfism (State Project 1451)

III. Personnel:

Experiment Station:

P. W. Gregory, F. D. Carroll, L. M. Julian, W. S. Tyler, T. J. Hage, and Wilmer J. Miller

U. S. Department of Agriculture, Agricultural Research Service

R. T. Clark, Coordinator, and J. S. Brinks

IV. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

All of the research done this year is a continuation of the work that has been in progress for the past several years, and falls into four general categories:

1. More data have been accumulated on the diagnostic criteria for all of the mutant achondroplastic forms. The intermediate fusion time of the spheno-occipital synchondrosis from 10 to 20 months of age now has been firmly established in comprest type cattle which are about 75% normal weight and 90% normal height. However, all comprest type cattle of this weight and height range do not exhibit the intermediate fusion time. This study is ready for publication.

2. The three metacarpal indices developed for Herefords (Tyler et al., 1961) have been applied to Angus brachycephalic dwarfs and to Angus dolichocephalic dwarfs. It was found that the Angus brachycephalic mutants are identical with the Hereford brachycephalic mutants in all three metacarpal indices, and also coincide with Hereford brachycephalic mutants in the intermediate fusion time. The Angus dolichocephalic achondroplastic mutant which has approximately the same height and weight as the Hereford brachycephalic achondroplastic mutant is identical with it in the three metacarpal indices, but differs with the Hereford in head characteristics in the cephalic index and the spheno-occipital fusion time. This study is being prepared for publication. A histological study of the epiphyseal line of the metacarpals of achondroplastic and control animals shows that the two stocks differ in cell content (Ticer et al., 1961).

3. The injection of hypophyseal extract from dwarf and normal cattle into the Snell dwarf mouse mutant provoked identical growth responses. This indicates that the cattle mutant and the mouse mutant are not homologous,

and suggests further that it is the target tissue of the cattle mutant which is deficient (Carroll and Gregory, 1962). This conclusion is in agreement with all of the anatomical studies.

4. Substantial progress has been made in all of the test matings.

a. The most sensational results have come from the mating of a Dexter bull to achondroplastic brachycephalic mutants, to dolichocephalic achondroplastic mutants, and to comprest mutants in which the achondroplasia may be either evident or suppressed. Each of these matings yielded two or more distinct types, discontinuous in size. What are assumed to be Dexter and Kerry types were produced from all three matings. It is significant that an achondroplastic calf which was sired by the Dexter bull from a comprest cow and died from bloat at an early age exhibited a fusing spheno-occipital synchondrosis.

b. Two small segregate cows, descended from dwarf-carrier Hereford cows, brachycephalic, dolichocephalic, comprest, and compact mutant stocks, bred to a Dexter bull aborted at seven months' gestation two Dexter "bulldog" achondroplastic calves identical with the type described by Crew (1923). One of these small segregate cows was later mated to a half-sib and aborted an achondroplastic "bulldog" calf at about four months of gestation. It is significant that these "bulldog" calves aborted at seven months of age exhibited a completely closed spheno-occipital synchondrosis.

c. Comprest type cows mated to a compact type bull produced 30 progeny that were consistently subnormal in weight and height. A number of these progeny exhibited intermediate fusion time of the spheno-occipital synchondrosis when slaughtered at 16 months of age.

All of the genetic and anatomical evidence indicates that Dexter, brachycephalic, dolichocephalic, comprest, and compact mutant types either possess different degrees and patterns of achondroplasia or are capable of producing progeny that possess degrees and patterns of achondroplasia identical with the original mutant stocks. This supports the hypothesis that achondroplasia is a complex comprised of several components and all of the experimental stocks studied are genetically related.

d. Progress continues on analysis of the bull from the New Mexico and Arizona stations. When this bull was mated to dwarf and comprest cows, he produced a certain percentage of progeny subnormal in size but none was the typical brachycephalic dwarf. When this bull was used in sire-daughter matings, he has produced to date a small percentage of hydrocephalic calves, one of which totally lacked the nursing instinct.

The tests on the bull from the Oregon station parallel in certain details that of the New Mexico bull.

Our anatomical studies reveal that a high percentage of brachycephalic dwarf calves have slightly enlarged lateral ventricles. A small percentage of brachycephalic achondroplastic dwarfs have greatly enlarged lateral ventricles which is typical of hydrocephalus, and may also show early fusion of the spheno-occipital synchondrosis, but may or may not exhibit the three metacarpal indices typical of brachycephalic achondroplastic dwarfs.

It also has been observed that progeny produced by crossing various types of achondroplastic mutants may exhibit extreme hydrocephalus and this is being checked further. From the extensive anatomical data at hand it seems doubtful if the hydrocephalous condition can be wholly separated from achondroplasia. This has support from reports of medical clinicians studying achondroplasia in man.

Bovine dwarfs have been compared to Hurler's syndrome of man. Hurler's syndrome has two characteristic features, (1) excessive excretion in urine of two distinct mucopolysaccharides, chondroitin sulfate-B and heparitin sulfate, and (2) intracellular storage of one or more sulfated mucopolysaccharides in the so-called gargoyle or clear cells in tissues from bovine dwarfs. Although an extensive search has been made at this station, we have been unable to find gargoyle or clear cells in tissues from bovine dwarfs, nor have they been found by other investigators. Results of the quantity and types of urinary mucopolysaccharides conflict.

Lorincz reported increased total urinary mucopolysaccharides, and the presence of chondroitin sulfate-B and hyaluronic acid. In our studies, conducted in cooperation with Dr. Karl Meyer of Columbia University, we found one short-headed dwarf with low excretion, and one with higher and possibly abnormally higher excretion of total urinary mucopolysaccharides. Fractionation and analysis revealed only chondroitin sulfate-A. No evidence was found of chondroitin sulfate-B or of heparitin sulfate. The methods used by Lorincz and by Meyer in our studies differed. We believe Meyer's methods of fractionation and identification of individual sulfated mucopolysaccharides are superior.

Two other laboratories using methods developed at Mayo Clinic studied urinary acid mucopolysaccharides of dwarf cattle. The results of the study conducted by the Mayo Clinic group supported the studies of the California station, and thus did not confirm Lorincz's results. McIlwain and Eveleth, using the Mayo Clinic methods, report conflicting results which support Lorincz's results.

In summary, there is conflicting evidence concerning the presence in dwarf cattle of the first characteristic of Hurler's syndrome of man. No one has found the second characteristic, namely gargoyle cells, in dwarf cattle. Anatomical evidence all indicates that the two conditions are not homologous.

VI. Application of Findings:

These studies (1) continue to contribute to normal and specific types of subnormal growth within cattle populations, to specific qualitative and quantitative traits of growth expression in living mutant forms, and to specific anatomical skeletal characteristics in the different stocks, (2) support the hypothesis that specific types of hydrocephalus are related to achondroplasia, and (3) continue to throw light on the nature of herd deterioration (loss of size and vigor) that is occurring in registered and commercial herds; also indicated is the nature of the processes essential for the restoration of vigor (heterosis) from the mating of different deteriorated types.

VII. Work Planned for the Future:

Attention will be directed to completion of all of the unfinished studies. The relation of the Dexter achondroplasia to the other achondroplastic types will receive much attention, and the Dexter × Dexter mating will be made under controlled conditions. Factors affecting herd deterioration and the restoration of vigor will continue to receive attention. Much time will be devoted to the preparation and publication of manuscripts.

VIII. Publications and Manuscripts:

Carroll, F. D., and P. W. Gregory
1962. Responses of the Snell dwarf mouse to pituitary tissue from a bovine dwarf mutant. Exp. Biol. and Med. Soc. Proc. 104:35-38.

Gregory, P. W., W. S. Tyler, and L. M. Julian
1961. Bovine achondroplasia. IV. Articulation of the lumbar vertebrae in brachycephalic dwarfs. Growth 25:254-279.

Gregory, P. W., L. M. Julian, and W. S. Tyler.
1961. Comparisons of achondroplastic brachycephalic dwarf segregates from comprest and control stocks. Amer. Zool. 1(4):107.

Ticer, J. W., W. S. Tyler, L. M. Julian, and P. W. Gregory
1961. Influence of achondroplasia on the width and cell content of an epiphyseal line. Amer. Zool. 1(4):222.

Tyler, W. S., L. M. Julian, and P. W. Gregory
1961. Bovine achondroplasia. III. Standard metacarpal indices for brachycephalic dwarfs and control cattle. Amer. J. Vet. Res. 22(89):693-697.

Tyler, W. S., L. M. Julian, and P. W. Gregory
1962. Sulphated mucopolysaccharides of urine from brachycephalic dwarfs. Amer. J. Vet. Res. 23(96):1109-1110.

Cattle Inventory IX. PROJECT SUMMARY Date: June 1962
Dwarf Herd California Agricultural Experiment Station

Type	Number	Total
1. Brachycephalic		
Females, breeding age	30	
Females, yearling	1	31
2. Dolichocephalic		
Females, breeding age	17	
Females, yearling	2	19
3. Comprest		
Females, breeding age	16	
Females, yearling	3	19
4. Recurrent Comprest		
Females, breeding age	4	4
5. Synthetic Comprest		
Females, breeding age	14	14
6. Dexter		
Females, breeding age	6	
Stock females, breeding age	9	
Stock females, yearling	2	17
7. Bulls, all types		
Mature	12	
Yearling (to be discarded at 16 months)	18	30
8. Heifers, yearling (not included elsewhere; to be discarded at 16 months of age)	12	12
9. 1962 calf crop		
Females	19	
Bulls	12	31
Total		177

UNIVERSITY OF CALIFORNIA

I. Station: California Agricultural Experiment Station, Davis, California

II. Present Project Title: Breeding experiments to investigate the nature of genetic improvement in beef cattle productivity with special emphasis on the performance of inbred lines and their crosses. (State Project 1216).

Proposed Project Title (for revised project): Studies of heterotic effects in crosses of the Angus, Hereford, and Shorthorn breeds

III. Personnel:

Experiment Station:
W. C. Rollins, leader, F. D. Carroll, and K. A. Wagnon

U. S. Department of Agriculture, Agricultural Research Service
R. T. Clark, Coordinator, and J. S. Brinks

IV. and V. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

A study of the comparison of a Rover line bull with a Colorado Brae Arden × Rover linecross bull in a topcross test at the Rector Ranch, Fresno, has been completed. Tables 1 and 2 give a summary of growth performance and carcass evaluations.

This has been a transition period involving the selling of the large part (about 100 head) of the Rover cattle to obtain funds for purchasing Angus, Hereford, and Shorthorn heifers called for in the revised project. Of the Rover cattle, there are 19 cows, 4 heifers, 10 calves, and 2 mature bulls left to carry on the line. All of these except the 2 bulls have been transferred to the Sierra Foothill Range.

Thirty-two Angus, 32 Hereford, and 33 Shorthorn heifers were purchased during the summer of 1961. Five heifers have died, leaving 30 Angus, 31 Herefords, and 31 Shorthorns. All are registered except 16 Angus and 8 Herefords.

Compared to the progeny of the Brae Arden × Rover linecross bull, the progeny of the Rover line bull produced heavier, leaner carcasses that were lower in quality. After equating quality and cutability, the two groups of carcasses were equal in value.

Tables 1 and 2 show the performance record of the bulls sent to the Rector ranch and the performance of their progenies.

Table 1.--Performance records of bulls

	Crossline No. 435	Inbred No. 441
Adjusted 240-day weaning weight	484	551
Daily gain from weaning to feedlot (127 days)	2.07	1.22
Daily gain in feedlot (112 days)	3.29	2.79
Weight at end of feedlot period	1110	994
Pounds TDN per cwt. gain	434	529
Slaughter grade	Choice	Top good
U. C. grade	2 (88)	2- (84)
Age at end of feed test (days)	529	523

Table 2.--Performance records of progeny

	Crossline		Inbred	
Calf crop weaned (percent)	86		76	
	Steers	Heifers	Steers	Heifers
Number weaned	19	13	13	15
Weaning weight	490	480	511	445
Weaning grade (Percent)	85.4	86.8	85.8	85.2
Yearling weight	771	722	807	698
Yearling grade (percent)	85.6	86.2	85.8	85.3
Carcass weight	768		772	
Quality grade score	18.2[1]		17.6[1]	
Yield of boneless primal cuts	47.0[2]		47.4[2]	
Pounds beef equivalent to low prime in quality	377		377	

[1]Top good = 18, good = 17

[2]Calculated by using rib eye area, fat thickness, kidney fat, and carcass weight

VI. Application of Findings.

The linecross vs. inbred line experiment is by no means conclusive for answering the question whether linecross bulls are better than inbred line bulls in topcrossing, but it will contribute to the answer when compared to comparable experiments not yet completed at other experiment stations.

VII. Work Planned for the Future

As outlined in new project.

VIII. Publications and Manuscripts

Rollins, W. C., F. D. Carroll, J. W. T. Pollock, and M. N. Kudoda 1962. Beef cattle performance and progeny tests for gain, efficiency, carcass conformation, and earliness of maturity. J. Anim. Sci. 21(2):200-206.

Cattle Inventory IX. PROJECT SUMMARY

California Agricultural Experiment Station

Breed	Angus	Hereford	Shorthorn
Purebred	14	23	31
Grade	16	8	0

Estimated cash value - $22,750

Land, Physical Facilities, and Equipment Used Date: June 1962

	Number	Actual cash value	Percentage used for breeding project
Barns and corrals	3	$100,000	75
Irrigated pastures	46 acres		100
Drylots and pastures	14 acres		100

COLORADO STATE UNIVERSITY

I. Station: Colorado Agricultural Experiment Station, Fort Collins, Colorado

II. Project Title: A study of selection, inbreeding, and the crossing of inbred lines within the Hereford breed (Project R. & M. 26)

III. Personnel

Experiment Station:

H. H. Stonaker, Kent H. Riddle, G. O. Harwin, J. A. Marchello, A. B. Canterbury, J. B. Armstrong, and B. W. Knapp

USDA: R. T. Clark, Coordinator and J. S. Brinks

IV. Nature and Extent of Work Done This Year and Summary of Progress and Conclusions to Date:

See General Series Paper 778, 1962 Field Day Report, pp. 2-13.

VI. Application of Findings:

VII. Work Planned for the Future:

Two questions concerning breeding plans need consideration:

1. Should performance-selected linecross bulls be progeny tested along with performance-selected inbred bulls? Trends toward greater divergence in performance of inbreds and hybrids and the increased interest of commercial breeders in high-performance bulls make the incorporation of such progeny tests seem a logical addition to the San Juan Basin breeding program. It is contemplated that for at least three years two high-indexing linecross bulls and high-indexing inbred bulls of the same lines would be mated to unrelated linecrosses.

2. It is contemplated that some of the better, longer-established single-sire lines at this point might be logically enlarged to two-sire lines with the most promising young bull each year tested against the principal herd sire in the line. This would seem to protect the line to a degree against random drift.

The convincing evidence of greater growth heterosis in females than in males encourages us to attempt to develop new projects with other species to further check the effects on growth of various sex chromosome combinations such as XX, XY, XO, ZW, ZZ, and ZO.

Breeding group differences in teat and udder shape and in interior pelvis size are under way. Small numbers of observations explain the wide range in heritabilities of teat and udder measurements and scores.

Characteristics of Steer Progeny Groups

Dean Brown, Los Olivos, California - 1962

Sires	5012	BD	T	4126	3016	L1-278	Mean
No. of calves	6	5	5	5	4	6	
			Ratios				
Weaning weight	114	91	103	95	101	96	474 lbs.
Feed cost - 135 days	96	99	89	104	107	100	$67.27
Av. daily gain - 135 days	100	91	92	105	114	99	2.96#/da.
Gain/feed	104	92	103	101	107	93	
Percent in Choice grade	124	148	92	72	37	124	57%
Marbling score	101	112	92	92	99	104	4.80
$ per cwt. carcass	100	101	100	100	99	100	$41.54/cwt.
Slaughter weight	108	95	97	99	108	93	906 lbs.
Carcass weight	108	95	101	98	107	91	564 lbs.
Est. returns over calf costs and feed	157	95	92	101	105	67	$37.62
Rib eye area	108	102	98	102	96	95	11.37 in.
Muscle/bone ratio shanks and rib sample	101	105	99	100	100	95	4.94
Results from retail trimmed cuts:							
% fat	100	104	104	89	110	93	11.35%
% bone	99	93	100	102	103	103	11.83%
% rib, loin, round	101	99	99	105	99	104	34.28%
Value of trim cuts/ 100# carcass	100	101	98	102	97	102	$49.05
Carcass weight × value trim cuts	108	96	99	100	104	93	
Marbling ratio/ % fat ratio	101	108	88	103	90	112	
Rib iodine no.	98	101	101	101	101	99	51.12
Kidney iodine no.	95	102	99	104	98	101	37.25
Rib melting point	101	98	100	101	100	101	41.26
Kidney melting point	102	99	100	99	101	99	49.45

An attempt is being made to estimate amounts of selection pressure actually exerted, and response. Repeat matings will be the basis for at least part of this estimation.

The more refined analysis of an evaluation of environmental effects is under way than has been done previously. Results of this should be known by 1963.

VIII. Publications and Manuscripts:

Stonaker, H. H.
196 . Homogametic heterosis. (Submitted to J. Anim. Sci.)

Stonaker, H. H.
196 . How to select beef bulls for artificial insemination. Successful Farming.

Stonaker, H. H.
196 . A long term program for beef cattle improvement. Successful Farming.

Harwin, G. O., H. H. Stonaker, and D. A. Cramer
1962. An evaluation of methods for the quantitative estimation of marbling in beef cattle.

Cattle Inventory IX. PROJECT SUMMARY
Purebred Colorado Agricultural Experiment Station

Breed	Hereford					
Line	Bonanza	Brae Arden	Colorado	Don	Monarch	Prospector
Bulls, 12 mos. or over	1+2	2+5	1+4	1+2	1+2	1+2
Cows, 2 yrs. or over	15	46	6	23	22	25
Heifers, yearling	7	10	5	4	3	8
Bull calves	9	19	2	10	10	9
Heifer calves	3	17	3	8	9	9
Percentage used for breeding project	100	100	100	100	100	100
Estimated cash value						

Cattle Inventory (Continued)

Purebred Colorado Agricultural Experiment Station

Breed	Hereford				
Line	Real Prince	Rover	Royal	San Juan	Tarrington
Bulls, 12 mos. or over	2+2	0+0	2+4	2+2	0+0
Cows, 2 yrs. or over	8	9	21	28	20
Heifers, yearling	1	0	2	5	0
Bull calves	3	2	8	12	5
Heifer calves	2	4	7	9	8
Percentage used for breeding project	100	100	100	100	100
Estimated cash value					

Breed	HXA-Sh.			
Line	Cross-bred	Control	Model Domino	On lease
Bulls, 12 mos. or over	0+0	1+2	0+0	2
Cows, 2 yrs. or over	9	15	1	78
Heifers, yearling	0	3	0	-
Bull calves	5	7	0	-
Heifer calves	4	6	0	-
Percentage used for breeding project	100	100	100	100
Estimated cash value				

Cow Production Data (by line of dam's sire) 1961 calving

Breed	Hereford					
Line	Bonanza		Brae Arden		Colorado	
	Inbred	Linecross	Inbred	Linecross	Inbred	Linecross
Cows bred to calve as 2-yr.-olds	2	-	6	5	-	-
Calves born from 2-yr.-olds						
Alive	1	-	2	4	-	-
Dead	0	-	0	0	-	-
Cows bred to calve at 3 yrs. and up	6	4	16	9	7	4
Calves born from 3 yrs. and up						
Alive	4	4	13	6	5	2
Dead	0	0	2	1	0	1
All calves born						
Alive	5	4	15	10	5	2
Dead	0	0	2	1	0	1
Total	5	4	17	11	5	3
Calves weaned	5	4	11	10	5	2
Percent calf crop						
Birth	62.5	100	77.3	78.6	71.4	75.0
Weaning	62.5	100	50.0	71.4	71.4	50.0

Calf Data (by line of calf's sire)

	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Inbreds												
Weaning age	2	190	2	170	7	202	4	194	1	150	4	206
Weaning weight		385		245		350		251		265		375
Adj. weaning weight-200 days		527		459		475		415		463		513
Wean. score--conf.		5.0		3.5		4.4		4.0		4.0		5.0
Inbreeding of calf		.34		.41		.40		.43		.42		.35
Inbreeding of dam		.36		.38		.40		.37		.28		.35
Linecrosses												
Weaning age			4	217	9	196	8	211			1	192
Weaning weight				416		414		442				205
Adj. weaning weight-200 days				428		442		463				276
Weaning score--conf.				5.0		4.9		5.6				2.0

Cow Production Data (by line of dam's sire) 1961 calving

Breed	Hereford					
Line	Don		Monarch		Prospector	
	Inbred	Linecross	Inbred	Linecross	Inbred	Linecross
Cows bred to calve as 2-yr.-olds			1	3	2	5
Calves born from 2 yr.-olds						
Alive			0	1	1	5
Dead			0	0	0	0
Cows bred to calve at 3yrs. and up	6	10	8	10	9	7
Calves born from 3 yrs. and up						
Alive	6	10	7	9	9	5
Dead	0	0	0	0	0	0
All calves born						
Alive	6	10	7	10	10	10
Dead	0	0	0	0	0	0
Total	6	10	7	10	10	10
Calves weaned	6	8	6	9	9	9
Percent calf crop						
Birth	100	100	77.8	76.9	90.9	83.3
Weaning	100	80.0	66.7	69.2	81.8	75.0

Calf Data (by line of calf's sire)

	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Inbreds												
Weaning age	5	214	1	187	2	215	4	191	4	221	5	209
Weaning weight		407		240		405		344		531		418
Adj. weaning weight--200 days		499		365		484		485		536		516
Wean. score--conf.		4.6		4.0		5.0		4.0		4.3		4.3
Inbreeding of calf		.38		.30		.28		.35		.19		.26
Inbreeding of dam		.30		.24		.28		.28		.28		.28
Linecrosses												
Weaning age	3	182	3	195	4	193	4	207	5	194	8	202
Weaning weight		388		423		404		420		407		407
Adj. weaning weight--200 days		423		475		443		436		424		441
Weaning score--conf.		5.0		4.0		5.5		5.3		4.5		4.6

Cow Production Data (by line of dam's sire) 1961 calving

Breed	Hereford		
Line	Real Prince Inbred Linecross	Rover Inbred Linecross	San Juan Inbred Linecross
Cows bred to calve as 2-yr.-olds		7	
Calves born from 2-yr.-olds			
Alive		5	
Dead		0	
Cows bred to calve at 3 yrs. and up			
Calves born from 3 yrs. and up			
Alive			
Dead			
All calves born			
Alive		5	
Dead		0	
Total		5	
Calves weaned		4	
Percent calf crop			
Birth		71.4	
Weaning		57.1	

Calf Data (by line of calf's sire)

	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Inbreds												
Weaning age	3	179	1	204					3	192	3	197
Weaning weight		299		400						347		395
Adj. weaning weight--200 days		461		481						470		515
Weaning score--conf.		3.0		5.0						4.3		4.7
Inbreeding of calf		.42		.20						.31		.20
Inbreeding of dam		.37								.24		.27
Linecrosses												
Weaning age	2	213							6	190	5	209
Weaning weight		440								370		394
Adj. weaning weight--200 days		449								413		431
Weaning score--conf.		5.0								4.2		4.4

Cow Production Data (by line of dam's sire) 1961 calving

Breed	Hereford	H×A-Sh.	Hereford
Line	Tarrington Linecross	Crossbred	Control
Cows bred to calve as 2-yr.-olds	7		2
Calves born from 2-yr.-olds			
Alive	6		2
Dead	1		0
Cows bred to calve at 3 yrs. and up	4	11	12
Calves born from cows 3 yrs. and up			
Alive	4	9	11
Dead	0	0	1
All calves born			
Alive	10	9	14
Dead	1	0	1
Total	11	9	15
Calves weaned	8	9	14
Percent calf crop			
Birth	100	81.8	100
Weaning	72.7	81.8	93.3

Calf Data (by line of calf's sire)

	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Inbreds	-	--	-	--								
Linecrosses												
Weaning age					4	185	5	218	6	203	6	204
Weaning weight						481		520		400		396
Adj. weaning weight--200 days						495		515		409		439
Weaning score--conf.						6.0		6.0		5.3		5.0

Colorado Agricultural Experiment Station

Feedlot Performance — Date: May 12, 1962

Breed	Hereford	Angus	Crossbred
Sex	Bulls	Bulls	Bulls
Number on test	92	2	4
Average:			
Age on test	-	-	-
Initial weight	437	720	496
Days on test	140	140	140
Gain per head			
Total	316	312	384
Average daily gain	2.26	2.23	2.75
Efficiency of feed utilization			
lbs. TDN/100 lbs. gain	7.25	9.70	6.58
Final weight	753	1032	880
Final score			
Conformation	4.8	5.4	5.8

Young Animals on Feed

Purebred — Date: May 12, 1962

	Hereford	Angus
	Number individually fed	Number individually fed
Bulls	92	2
Heifers	-	-
Steers	-	-
Grade - Crossbred (H X Angus - Shorthorn)		
Bulls	4	
Heifers		
Steers		

UNIVERSITY OF HAWAII

I. Station: Hawaii Agricultural Experiment Station, Honolulu, Hawaii

II. Project Title: The estimation of genetic and phenotypic parameters in populations of beef cattle in Hawaii and their use in selection programs

III. Personnel:

Experiment Station:

Estel H. Cobb, Oliver Wayman, Isaac Iwanaga, Kiyoichi Morita, and Valentino Arganosa (also managers of cooperating ranches and their stock-handling personnel)

U. S. Department of Agriculture, Agricultural Research Service

R. T. Clark, Coordinator, and J. S. Brinks

IV. and V. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

Weights and conformation scores at weaning, 12 months, and 20 months of age were obtained as planned. The third group of test males were selected at weaning and castrated for progeny testing for rate of gain and carcass characteristics.

The data from the first year of the progeny testing were analyzed for the effects of sires, treatments, and sire × treatment interaction. Data were available on 41 steers from 7 sires. Twenty steers were fattened in the feedlot, and 21 were finished on Para grass pasture supplemented with cane molasses and soybean oil meal. The following traits were investigated: rate of gain, slaughter grade, percent retail cuts, percent wholesale cuts, carcass grade, rib eye area, dressing percent, percent waste, marbling score, and carcass specific gravity.

The feedlot steers were significantly better than the pasture steers in rate of daily gain, slaughter and carcass grades, percent rib, dressing percent, marbling score, and carcass specific gravity.

Small sire differences were noted for all traits except specific gravity. A significant sire × treatment interaction was obtained for rib eye area.

The simple correlation coefficients among the different traits were computed. Only a few of the traits were highly correlated. The following table gives a few of the more interesting correlations.

Table 1.--Correlations among the different traits[1]

2	Slaughter grade (2)	Percent retail cuts (3)	Carcass grade (8)	Rib eye area (9)	Dressing percent (10)	Percent waste (11)	Marbling score (12)	Specific gravity (13)
Av. daily gain (1)	0.47	0.24	0.45	-0.26	0.05	-0.13	0.43	-0.26
(2)		-0.24	0.36	0.35	0.22	0.37	0.38	-0.38
(3)			-0.01	-0.05	-0.14	-0.88	-0.08	0.56
(8)				-0.04	0.03	0.20	0.88	-0.47
(9)					0.12	0.13	-0.11	-0.14
(10)						0.19	-0.06	-0.27
(11)							0.24	-0.75
(12)								-0.39

[1] A correlation of 0.308 is significant at 5 percent level; a correlation of 0.389 is significant at 1 percent level.

[2] The numbers inside the parenthesis in this column refer to the same numbers of the traits in the upper row.

The most striking results of this study were the significant correlations among average daily gain, slaughter grade, carcass grade, and marbling score, and among percent retail cuts, percent waste, and carcass specific gravity.

The low correlation of rib eye area with the measures of carcass quality and yield of retail cuts indicated that rib eye area has a low predictive value for quality and lean meat yield.

The second and third years' steers are on test at the present time. A more complete analysis of the data will be carried out when additional records are available.

Heritabilities were computed for weaning score (45%), daily gain from birth to weaning (42%), and weaning weight (29%). These heritabilities were computed from intra-sire regression of daughter on dam within year and ranch. Data from 203 daughter-dam pairs and 30 sires were used.

VI. Application of Findings:

Ranchers have shown an increased interest in record-of-performance programs in Hawaii. Several large ranches are starting programs this year. Two schools on record of performance were held with the ranchers to make available the adjustment factors which have been computed under the project.

VII. Work Planned for the Future:

Plans call for continuation of the progeny testing for rate of gain and carcass characteristics under pasture and feedlot conditions.

The collection of conformation scores and liveweights on the cattle at 8, 12, and 20 months of age on the ranch will continue as planned.

A University beef cattle station will be established this coming year on the island of Hawaii. A beef cattle breeding herd will be established to further the work under this project. Considerable thought is being given to increasing the emphasis on the study of genetic-environmental interactions.

VIII. Publications and Manuscripts:

Arganosa, Valentino G.
1962. Progeny testing of beef cattle under two feeding regimes. M.S. Thesis. June.

Arganosa, Valentino, and Estel H. Cobb
1962. Comparison of the progeny from different sires fattened under two different feeding regimes. (To be submitted as Technical Progress Report from the Hawaii Station.)

Cobb, Estel H.
1961. Beef cattle breeding research in Hawaii. Paper presented at Pacific Science Congress.

Cobb, Estel H.
1961. Improving animals for the future. Hawaiian Academy of Science Proc. November 8.

Cobb, Estel H., Oliver Wayman, and Valentino Arganosa
1961. Phenotypic correlations between conformation scores and liveweights at 8, 12, and 20 months of age and rate of gain of beef cattle. West. Sect. Amer. Soc. Anim. Prod. Proc. 12:XIX-1-5.

Cattle Inventory — IX. PROJECT SUMMARY — Date: June 1962

Grade — Hawaii Agricultural Experiment Station

Breed	Hereford
Line	Kaalualu & Kapapala
Station	Hawaii
Bulls, 12 mos. or over	106
Cows, 2 yrs. or over	407
Heifers, yearlings	153
Bull calves	183
Heifer calves	152
Percentage used for breeding project	100%
Estimated cash value	$350,000

Cow Production Data — Date: June 1962

Breed	Hereford
All calves born	
Alive	309
Dead	9
Total	318
Calves weaned	303
Percent calf crop[1]	
Birth	84
Weaning	82

	Kaalualu		Kapapala		Martin		Martin Crosses		Kapapala × Kaalualu	
	Bulls	Heif.	Bulls	Heif.	Bulls	Heif.	Bulls	Heif.	Bulls	Heif.
Number										
Av. wean.:	21	29	23	26	5	9	40	32	48	43
Age	254.6	257.9	268.0	271.2	247.6	253.9	270.4	276.2	267.6	266.3
Weight[2]	371.3	377.6	349.2	365.4	323.6	297.0	385.8	371.2	398.9	381.8
Adj. wt.	355.4	356.3	320.6	331.9	316.2	284.9	350.5	341.4	364.8	351.1
Conf. score[3]	3.95	4.28	3.91	4.23	4.00	3.44	4.02	4.28	4.40	4.60

[1] Based on number of calves alive and number of cows exposed to the bull.
[2] Overnight shrink without feed or water
[3] Based on grading system where 9 is highest score and 1 is the lowest

Young Animals on Feed — Date: June 1962

	Hereford	
	Number pasture fed	Number group fed
Grade steers	40	8

Land, Physical Facilities, and Equipment Used

Item	Number	Actual cash value	Percentage used for breeding project
Land, (acres) Kaalualu	2070	$ 22,700	100 annual lease value
Corrals, chutes, & scale	1 set	5,000	100
Portable scale	1	650	80
University of Hawaii			
Pasture (acres) irrigated	12.5	12,500	100
Portable scale	1	650	50
Corrals, chutes, scale, and barn	1 set	10,000	90
Meat laboratory	1	80,000	75
Working horse	1	250	80
Irrigation system	1	15,000	60
Profilometer	1	200	100
Leica camera set	1	613	50
Electronic ejaculator	1	544	100
Monroe adding machine	1	238	65
Friden calculator	1	659	80
IBM electric typewriter	1	270	20
Stenorrette dictating machine	1 set	485	100
Miscellaneous equipment		588	100
Total Value		$150,347	

UNIVERSITY OF IDAHO

I. Station: Idaho Agricultural Experiment Station, Moscow, Idaho

II. Project Title: The improvement of beef cattle through: (1) line-breeding within the Hereford and Shorthorn breeds, (2) testing line-bred sires within the various lines which will be developed, and (3) determining the relative importance of various reproductive phenomena

III. Personnel:

Experiment Station:

R. E. Christian, C. W. Hodgson, T. D. Bell, L. E. Orme, and S. E. Slyter

U. S. Department of Agriculture, Agricultural Research Service

R. T. Clark, Coordinator, and J. S. Brinks

IV. and V. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

Eighteen bull calves (12 Hereford, 3 Angus, and 3 Shorthorn) were individually fed for 140 days following weaning to obtain feedlot gain and feed efficiency. The average rate of daily gain for the Herefords was 1.65 pounds, for the Angus 1.81 pounds, and for the Shorthorns 1.67 pounds. The Herefords required 433.0 pounds of total digestible nutrients per 100 pounds of gain, the Angus 461.5 pounds, and the Shorthorns 419.4 pounds.

These 18 bulls also were used in a study to determine age at which it is possible to obtain satisfactory semen samples by the use of an electro-ejaculator, and the changes in semen quality with age in the young beef bull.

Attempts at semen collection were initiated when the bulls were approximately 8 months of age, and were continued at biweekly intervals up to 14 months of age, and at 4-week intervals thereafter.

Following a successful ejaculation, the following data were recorded: volume of semen, appearance of ejaculate, initial progressive motility, sperm concentration, and total sperm number. Each ejaculate was then divided into two portions, and one portion was diluted 1:100 with modified Kreb's solution while the other remained as undiluted semen. Both the diluted and undiluted samples were stored at 40° F. Daily microscopic examinations were made to determine the duration of motility. The following table shows the results of this study.

	Age at first erection	Age at first successful ejaculation	Earliest age at least 50% motility	Earliest age at least 10^8 sperm/cc.	Age of first successful satisfactory sample
Hereford	303.5	340.2	348.5	340.2	341.2
Angus	275.0	347.0	391.0	383.0	401.7
Shorthorn	263.7	329.7	335.3	329.7	340.3

These results would indicate that (1) Shorthorn and Angus bulls can be stimulated with an electroejaculator at an earlier age than the Hereford as shown by the age at first erection in the table above, (2) the Shorthorn and Angus bulls were more sensitive than the Hereford to electrical stimulation, and (3) successful ejaculates when obtained required less electrical current for the Angus than for the Shorthorns and Herefords. Successful ejaculates were obtained from all three breeds at average ages of less than one year. However, satisfactory semen samples, as measured by having at least 10^8 sperm per cc. with at least 50 percent initial progressive motility, were not obtained until approximately one year of age. The correlation between age at first erection and first successful ejaculation was .241.

Progressive motility above 50 percent was maintained for 2.5 days, 0.67 days, and 2.3 days in the raw semen samples from the Herefords, Angus, and Shorthorn, respectively.

This study will be continued with approximately the same number of bulls from the 1962 calf crop.

This past year 8 yearling Hereford bulls were leased to 4 cooperating ranchers, each receiving two bulls. These bulls now are being used for breeding, and the calves will be born next spring. When the calves are weaned, approximately 8 to 10 steer calves from each bull will be brought back to the University to be fed out.

The pairs of bulls were as follows:

Ranch A - Both bulls sired by same sire and as different as possible in rate of gain on the performance test

Ranch B - Both bulls sired by same sire and as different as possible in type score at 18 months of age

Ranch C - Each bull by a different sire and with as nearly as possible the same rate of daily gain on the performance test

Ranch D - Each bull by a different sire and with as nearly as possible the same type score at 18 months of age

These bulls will be used for two years in the same herds. Additional bulls will be leased to other cooperators this year.

VI. Application of Findings:

Very little information is available on age at puberty in the beef bull, or to what extent semen characteristics at an early age can be used to predict future breeding behavior. The results of the study this past year indicate that the beef bull first produces satisfactory semen at approximately one year of age. However, age at first erection is not a satisfactory index of the age at which the bull will produce satisfactory semen. The Angus and Shorthorn breeds are more sensitive to electrical stimulation than the Hereford breed, and therefore achieve erections at an earlier age. However, all three breeds produce satisfactory semen samples at about the same age.

VII. Work Planned for the Future:

The study on semen production in the young beef bull will be continued with bull calves from the 1962 calf crop. The present bulls will be continued on the study up to 18 months of age. Several of these bulls will be leased to cooperating ranchers from whom it will be possible to obtain information on their fertility. This information will be correlated with the data on semen productions.

The first calves from leased University bulls will become available this fall. They will be fed out, and production and carcass information will be obtained.

Additional pairs of bulls will be leased to cooperating ranchers this fall in the progeny testing phase of the project.

VIII. Publications and Manuscripts: None.

Cattle Inventory IX. PROJECT SUMMARY Date: June 30, 1962
Purebred Idaho Agricultural Experiment Station

Breed	Hereford	Angus	Shorthorn	
Line				Carrier
Station	Main	Main	Main	Main
Bulls, 12 mos. or over	16	7	4	0
Cows, 2 yrs. or over	66	25	26	8
Heifers, yearlings	12	5	6	0
Bull calves	27	7	10	3
Heifer calves	22	10	9	4
Percentage used for breeding project	60	60	60	100
Estimated cash value	49,800	21,100	24,700	3,100

Idaho Agricultural Experiment Station

Cow Production Data — Date: June 30, 1962

Breed	Hereford		Shorthorn		Angus	
Cows bred to calve at 3 yrs. and up	54		23		20	
Calves born from 3-yr.-olds and up						
Alive	47		16		19	
Dead	2		1		0	
All calves born						
Alive	47		16		19	
Dead	2		1		0	
Total	49		17		19	
Calves weaned	46		16		19	
Percent calf crop						
Birth	87.0		69.56		95.0	
Weaning	85.2		69.56		95.0	
	Bulls	Heifers	Bulls	Heifers	Bulls	Heifers
	No. Av.	No. Av.	No. Av.	No. Av.	No. Av.	No. Av.
Average:						
Birth weight	26 73.8	21 69.95	3 69.3	13 60.38	9 82.11	10 65.2
Weaning age	167.92	163.28	172.67	171.15	171.88	175.1
Weaning weight	357.2	332.38	341.3	283.85	420.55	343.4
Adj. weaning wt. - 200 days	412.20	389.48	384.3	322.46	474.33	384.0
Weaning score Conformation	10.84	11.19	11.67	10.46	11.89	11.1

Feedlot Performance

Breed	Hereford	Angus	Shorthorn
Sex	Bull	Bull	Bull
Number on test	12	3	3
Average:			
Age on test	205.2	212.0	200.7
Initial weight	436.8	510.0	392.7
Initial score Conformation	11.4	13.0	11.7
Days on test	140	140	140
Gain per head	229.4	251.7	232.3
Average daily gain	1.65	1.81	1.67
Efficiency of feed utilization TDN/100 lbs. gain	433.0	461.5	419.4
Final weight	666.2	761.7	625.0
Final score Conformation	11.3	12.7	12.0

Young Animals on Feed

Purebred	Hereford Number individually fed	Angus Number individually fed	Shorthorn Number individually fed
Bulls	12	3	3

MONTANA STATE COLLEGE

I. Station: Montana Agricultural Experiment Station, Bozeman, Montana, and the North Montana Branch Station, Havre, Montana

II. Project Title: Recurrent selection and record-of-performance selection in open and closed beef cattle herds (W-1, M.S. 873, A.I. 104, North Montana Branch Station 71.)

A. 1. The establishment of inbred lines of registered Hereford cattle, both horned and polled, that will result in improvement in such characteristics as rate and economy of gain, fertility, nursing ability, longevity, and carcass quality.

2. Maintain an outbred herd of Herefords with bulls selected and furnished by the purebred breeders. The bulls are to be primarily good, high-scoring individuals according to breed association standards.

B. 1. Establishment of an improved herd of registered Angus cattle in which the males are selected on a high level of performance as indicated by standard record-of-performance procedures.

C. 1. Investigate feasibility of breeding for specific combining ability through recurrent selection.

III. Personnel:

Montana State College:

Experiment Stations:

Bozeman, Montana:

F. S. Willson, leader, A. E. Flower, leader, R. W. Miller, J. R. Dynes, and N. A. Jacobsen

North Montana Branch Station, Havre:

Claude Windecker, Superintendent

U. S. Department of Agriculture, Agricultural Research Service

N. M. Kieffer, Superintendent, U. S. Range Livestock Experiment Station, Miles City, Montana

R. T. Clark, Coordinator, and J. S. Brinks

IV. and V. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

Bozeman

We indexed 14 Hereford bulls and 15 Angus bulls again this year. These were by the same sires as those reported last year. It is the last crop

of calves that will be indexed as a result of the cooperative test with the Montana Hereford Association and the Montana Angus Association as this work has discontinued last year. There were 12 Hereford heifers and 11 Angus heifers fed during the winter.

Havre

There was a total of 53 station steers and 24 ranchers' steers on feed. Thus, one goal of the North Montana selection program--topcrossing merit--is being checked by loaning ranchers' bulls of high-gaining ability from the Havre line. Comparisons are made by obtaining an equal number of ranchers' steers from their own bulls. These trials are indicating the value of gaining ability in commercial calf production.

Steers were limited to three pounds of hay after February 1, 1961 to increase grain intake. Gains averaged appreciably more than in recent years.

	Number on test	Initial weight	Final weight	Total gain	Average daily gain	Days on test	Carcass grade
637, Control	9	460	1932	577	2.44	236	7-Choice 2-Good
Line I, 714	4	462	1052	590	2.61	225	4-Choice 3-Choice
Line I, 717	4	455	1018	563	2.25	250	1-Good 2-Choice
Line II, 730	6	418	1019	601	2.53	238	4-Good 4-Choice
Line II, 749	6	405	998	593	2.35	255	2-Good 5-Choice
Line III, 739	6	385	1011	626	2.48	252	1-Good 6-Choice
Line III, 649	7	451	1027	576	2.40	240	1-Good 3-Choice
Rancher, IV	5	438	1003	565	2.20	258	2-Good 4-Choice
Rancher, IV, Line III	6	455	1051	596	2.51	238	2-Good 4-Choice
Rancher, VI	5	365	924	559	2.11	264	1-Good 3-Choice
Rancher, VI, Line II	6	396	977	581	2.24	260	3-Good
Line II, pure-bred steers	4	344	974	630	2.47	253	4-Choice

In addition to slaughter grade, fat-bone-lean and shear force for tenderness samples were taken for all lots of steers. A report is included in table form.

Sire	Number samples	Percent lean	Percent fat	Percent bone	Shear force
Control					
637	5	55.6	29.8	14.6	8.1
Line I 714	2	49.8	35.4	14.8	8.9
Line I 717	2	55.9	30.1	14.0	6.9
Line II 730	3	58.0	27.0	14.9	9.0
Line II 749	3	56.4	27.9	15.6	7.1
Line III 739	3	54.5	30.0	15.5	8.0
Line III 649	3	52.8	30.0	17.1	8.3
Ranch IV	2	52.7	31.4	15.9	11.7
Rancher IV × Line III	3	51.2	34.5	13.9	7.4
Rancher VI	3	56.3	26.8	16.9	6.2
Rancher VI × Line II	3	57.4	27.5	15.1	7.8
Line II Purebred	1	52.5	32.1	14.3	5.5

Table 1.--Heifer calves fed ad libitum second cutting hay, 140 days 1961-62

Sire	Number heifers	Initial weight	Final weight	Total gain	Average da. gain	Weaning score
Line I 111	9	408	571	114	.81	71.8
Line II 169	15	409	532	124	.88	78.7
Line III 739	4	467	571	103	.74	78.8
Miles City 791	12	470	577	107	.76	80.1
Line I 813 × Miles City Line	3	428	547	120	.85	79.3
Line I 820 × Miles City Line	3	438	589	125	.89	78.5
Line II 824 × Miles City Line	3	442	545	102	.78	78.8
Line II 827 × Miles City Line	3	464	573	108	.78	78.9
Line III 814 × Miles City Line	3	403	529	126	.90	78.8
Line III 649 × Miles City Line	Only one heifer--not tested					

Bull 827 disposed of, extreme line back
Bull 814 disposed of, extremely poor conformation, and nervous
Bull 649 disposed of, too wild to handle
Bull 169 disposed of, poor bone structure, knees developed enlarged structure and buckled out

The Bozeman results of test breeding at the Miles City station are running about the way they have in the past. The visually selected sire progeny group are at the bottom of the Hereford sire groups, and our ROP sire group from Bozeman is considerably better than any of the Hereford lines in performance this year at Miles City. This is the second year out of four that the ROP Bozeman line has performed better than any of the Miles City Hereford lines in the test at Miles City. The carcasses have graded a little better also. As soon as the feedlot tests are completed, the summary of the four-year test breeding with these two lines from Bozeman will be made.

In the Angus comparisons, we have used the same visually selected Angus bull which outperformed our ROP California bull last year, and he did it again this year. This was particularly true with the bulls. However, the ROP heifers did better than the visually selected group.

VI. Application of Findings:

Montana Beef Performance Association reports a steady gain in membership with corresponding gain in certified commercial calves, i.e., between 7,000 and 8,000 and over 2,400 purebred yearling bulls and heifers in their indexing programs. Cooperative tests by members of this association and the Agricultural Extension Service of Iowa State University at feedlots near Humboldt, Iowa have created considerable interest. Ninety-six head of certified feeder calves produced in Montana, as well as over a hundred head of noncertified calves produced in Montana, were put in an Iowa man's feedlot. He reports that he marketed 70 pounds more gain per head from the certified calves. The carcass yield and the carcass quality of the two groups were practically identical.

The Experiment Station at Bozeman conducted a test in which we fed out 20 head of certified calves from a Montana member in the program, and we bought 20 head of other calves on the open market. These were equally distributed among treatments in a nutrition trial. Here, similarly, we found that we had 69 pounds of gain in weight advantage in favor of the certified steers. The carcass quality again was of no significant difference. Feeder buyers are putting pressure on our commercial cattle producers, and commercial cattle producers in turn are putting pressure on the purebred breeders to get high-indexed bulls.

VII. Work Planned for the Future:

Bozeman

We will summarize the comparisons in the indexing test between our outbred herd and our linebred record-of-performance Hereford group, as well as the two groups of Angus - ROP versus the visual appraisal selected sire groups. We will also summarize the topcrossing of our two Hereford lines on Miles City tested cows and try to get some carcass data on our Angus ROP herd in comparison with industry cattle of the same breed.

Havre

We plan to continue rancher cooperative topcrossing tests. There are three cooperators in this program for 1962-63. Two additional rancher steer groups will be fed for comparisons, one group representing 25 years of matings to bulls from a privately owned linebred herd.

If feed conditions are satisfactory, a couple of sets of heifer calves will be obtained from cooperating ranchers to test on ad lib hay feeding.

In 1961, an outcross bull was obtained from the Montana State College outcross herd and bred to station test herd cows. These steers will be fed in 1962-63 trials.

Because of poor calf crops from yearling bulls, a change is being made to use two-year-old bulls in crossline testing.

Work will continue in bone-fat-lean and shear test on samples from each line to complete carcass data on ROP and rancher cattle.

A ten-year study on heterosis and selection differentials at Havre is under way in cooperation with workers at the Bozeman station and the W-1 Regional office at Denver.

VIII. Publications and Manuscripts:

Jacobsen, N. A.
1961. Montana Beef Performance Association designed to aid producer. West. Livestock Rptr., Billings. December.

Jacobsen, N. A.
1962. Look who's raising calves. Mont. Stockgrower. February.

Windecker, Claude
1962. Results of beef research at North Montana Branch Station. Mont. Stockgrower 34(4).

Windecker, Claude
1962. Three years of comparative work with rancher and ROP steers at North Montana Branch Station. Hereford J. July 1.

Cattle Inventory (Bozeman) IX. PROJECT SUMMARY Date: June 6, 1962

Purebred Montana Agricultural Experiment Station

Breed	Angus	Angus	Hereford	Hereford
Line	ROP	Show Type	ROP	Show Type
Station	Bozeman	Bozeman	Bozeman	Bozeman
Bulls, 12 mos. or over	4	6	10[1]	7[2]
Cows, 2 yrs. or over	27	13	32	19
Heifers, yearling	8	3	11	1
Bull calves	15	5	13[3]	8[5]
Heifer calves	7	5	16[4]	5[6]
Percentage used for breeding project	60	60	60	60
Estimated cash value	$8,650	$4,800	$18,700	$8,250

[1]Includes 3 bulls at Red Bluff Ranch
[2]Includes 3 bulls at Red Bluff Ranch
[3]One crossline bull calf
[4]Two crossline heifer calves
[5]One crossline bull calf
[6]Two crossline heifer calves

Cattle Inventory (Havre) IX. PROJECT SUMMARY Date: June 10, 1962

Purebred North Montana Branch Station

Breed	Hereford	Hereford	Hereford
Line	Line I	Line II	Line III
Station	Havre	Havre	Havre
Bulls, 12 mos. or over	9	12	7
Cows, 2 yrs. or over	26	25	17
Heifers, yearling	6	8	4
Bull calves	9	9	9
Heifer calves	12	6	8
Percentage used for breeding project	100	100	100
Estimated cash value	$13,300	$17,850	$11,850

Grade			
Breed	Hereford		Hereford
Line	M.C.Control		Crossline
Station	Havre		Havre
Bulls, 12 mos. or over	1		0
Cows, 2 yrs. or over	96		0
Heifers, yearling	12		26
Steer calves	38		0
Heifer calves	33		0
Percentage used for breeding project	100		to be sold
Estimated cash value	$33,325		$3,900

Cow Production Data - Bozeman

Breed	Hereford							
Line	ROP				Show Type			
Cows bred to calve as 2-yr.-olds	10				10			
Calves born from 2-yr.-olds								
Alive	8				7			
Dead	0				2			
Cows bred to calve at 3 yrs. and up	24				19			
Calves born from 3 yr. olds and up								
Alive	24				17			
Dead	0				1			
All calves born								
Alive	32				24			
Dead	0				3			
Total	32				27			
Calves weaned	31				24			
Percent calf crop[1]								
Birth	94.1				93.1			
Weaning	91.2				82.7			
	Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Birth weight	14	77.1	17	72.4	11	77.6	13	72.9
Weaning age		214		212		208		216
Weaning weight		406		384.8		410		374.2
Adj. weaning weight 180 days		351.4		337.8		362		323.3
Weaning score Conformation		75.9		77.2		79.4		76.8

[1]Cows bred divided into calves born and calves weaned

Cow Production Data - Bozeman

Breed	Angus							
Line	ROP				Show Type			
Cows bred to calve as 2-yr.-olds					9			
Calves born from 2-yr.-olds								
Alive					8			
Dead					0			
Cows bred to calve at 3 yrs. and up	13				19			
Calves born from 3-yr. olds and up								
Alive	13				18			
Dead	0				0			
All calves born								
Alive	13				26			
Dead	0				0			
Total	13				26			
Calves weaned	13[1]				25			
Percent calf crop[2]								
Birth	100				92.9			
Weaning	100				89.3			
	Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Birth weight	6	65.5	7	53.1	12	63.9	13	60
Weaning age		233		229		227		227
Weaning weight		463		348		463		419
Adj. weaning weight 180 days		372		295		381		344
Weaning score Conformation		79.8		72.4		75.1		76.5

[1]One cow died, calf grafted on cow in ROP line--calf data included here

[2]Cows bred divided into calves born and calves weaned

Cow Production Data - Havre 1960-61

Breed	Polled Hereford	Hereford	
Line	I 111	II 169	III 739
Cows bred to calve as 2-yr.-olds	4	5	6
Calves born from 2-yr.-olds			
Alive	3	5	4
Dead	1	0	0
Cows bred to calve at 3 yrs. and up	20	22	12
Calves born from 3-yr.-olds and up			
Alive	18	20	10
Dead	0	1	1
All calves born			
Alive	21	25	14
Dead	1	1	1
Total	22	26	15
Calves weaned	21	24	14
Percent calf crop[1]			
Birth	91.6	96.0	83.0
Weaning	87.5	88.9	77.8

	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Birth weight	12	86	9	72	9	84	15	80	8	75	6	74
Weaning age		185		194		176		175		174		185
Weaning weight		388		386		417		391		375		343
Adj. weaning weight 180 days		379		362		424		400		384		407
Weaning score Conformation		69		71.8		73		78.7		76		78.9

[1]Percent calf crop calculated on basis of calves born to cows exposed, and calves weaned to cows exposed

Cow Production Data - Havre 1960-61 (Used yearling bulls)

Breed	Hereford					
Line	Test Herd 791		Test Herd 813		Test Herd 820	
Cows bred to calve as 2-yr.-olds			6		6	
Calves born from 2-yr.-olds						
Alive			3		4	
Dead			2		0	
Cows bred to calve at 3 yrs. and up	32		15		15	
Calves born from 3-yr.-olds and up						
Alive	29		8		6	
Dead	0		0		2	
All calves born						
Alive	29		11		10	
Dead	0		2		2	
Total	29		13		12	
Calves weaned	28		11		10	
Percent calf crop[1]						
Birth	90.6		62		57	
Weaning	87.5		52.4		47.6	
	Steers	Heifers	Steers	Heifers	Steers	Heifers
	No. Av.	No. Av.	No. Av.	No. Av.	No. Av.	No. Av.
Birth weight	16 87	12 76	8 84	3 82	6 79	4 74
Weaning age	183	190	176	175	184	192
Weaning weight	462	455	424	420	396	429
Adj. weaning weight--180 days	456	435	431	436	388	407
Weaning score Conformation	81	80.1	77	80	73	78.5

[1]Percent calf crop calculated on basis of calves born to cows exposed, and calves weaned to cows exposed

Cow Production Data - Havre 1960-61 (Used yearling bulls)

Breed	Hereford			
Line	II		II	
	Test Herd 824		Test Herd 827	
Cows bred to calve as 2-yr.-olds	7		6	
Calves born from 2-yr.-olds				
Alive	6		4	
Dead	1		1	
Cows bred to calve at 3 yrs. and up	14		14	
Calves born from 3-yr.-olds and up				
Alive	8		9	
Dead	1		0	
All calves born				
Alive	14		13	
Dead	2		1	
Total	16		14	
Calves weaned	14		13	
Percent calf crop[1]				
Birth	76		70	
Weaning	66.7		65.0	

	Steers		Heifers		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Birth weight	8	78	5	72	10	82	3	71
Weaning age		181		181		177		181
Weaning weight		415		402		347		461
Adj. weaning weight--180 days		412		399		352		458
Weaning score Conformation		78		78.8		73		78.9

[1]Percent calf crop calculated on basis of calves born to cows exposed, and calves weaned to cows exposed

Cow Production Data - Havre 1960-61 (Used yearling bulls)

Breed	Hereford							
Line	III Test Herd 814				III Test Herd 649			
Cows bred to calve as 2-yr.-olds	6				8			
Calves born from 2-yr.-olds								
Alive	4				5			
Dead	0				0			
Cows bred to calve at 3 yrs. and up	13				14			
Calves born from cows 3 yrs. and up								
Alive	4				7			
Dead	0				0			
All calves born								
Alive	8				12			
Dead	0				0			
Total	8				12			
Calves weaned	8				12			
Percent calf crop[1]								
Birth	42				54.5			
Weaning	42				54.5			
	Steers		Heifers		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Birth weight	4	70	4	78	9	85	3	70
Weaning age		178		159		167		176
Weaning weight		398		381		381		375
Adj. weaning weight--180 days		401		421		403		381
Weaning score Conformation		74		78.8		78		77.5

[1]Percent calf crop calculated on basis of calves born to cows exposed, and calves weaned to cows exposed

Montana Agricultural Experiment Station

Feedlot Performance (Bozeman) 1961-62

Breed	H	H	H	H	Angus	Angus	Angus	Angus
Line	Show Type	Show Type	ROP	ROP	Show Type	Show Type	ROP	ROP
Sex	Bulls	Heifers	Bulls	Heifers	Bulls	Heifers	Bulls	Heifers
Number on test	5	1	9	11	6	3	9	8
Average:								
Age on test	232	288	238	264	257	290	255	280
Initial weight	447	498	490.2	494	508	492	530	512
Initial score								
Conformation	79.6	81	78.3	78.7	79.8	81	76.3	78.6
Days on test	140	112	140	112	140	112	140	112
Gain per head								
Total	279	176	306	178.7	308	153	287	194
Av. daily gain	1.99	1.57	2.18	1.60	2.2	1.37	2.05	1.74
Efficiency of feed utilization								
#feed/100# gain	713.8	-	677	-	724	-	776	-
Average:								
Final weight	726	674	796	673	816	646	817	706
Final score								
Conformation	79.2	83	78.7	79	79.8	81	78.8	81

North Montana Branch Station

Feedlot Performance (Havre) Date: June 12, 1962

Breed	Hereford	Hereford	Hereford	Hereford
	Controls	Line I	Line I	Line II
Line	637	714	717	730
Sex	Steer	Steer	Steer	Steer
Number on test	9	4	4	6
Initial weight	460	462	455	418
Initial score	72.3	78.4	73.7	71.9
Days on test	236	225	250	238
Gain per head				
Total	577	590	563	601
Av.daily gain	2.44	2.61	2.25	2.53
Final weight	1032	1052	1018	1019
Final score	7-Ch. 2-Good	4-Choice	3-Ch. 1-G	2-Ch. 4-G

Feedlot performance for 1959-60 steers. Finished in 1961.

North Montana Branch Station

Feedlot Performance (Havre)--Continued — Date: June 12, 1962

Breed	Hereford	Hereford	Hereford	Hereford
	Crosslines	Line III	Line III	Rancher IV
Line	Line II 749	739	649	
Sex	Steer	Steer	Steer	Steer
Number on test	6	6	7	5
Initial weight	405	385	451	438
Initial score	74.7	71.6	76.2	66.7
Days on test	255	252	240	258
Gain per head				
Total	593	626	576	565
Av. daily gain	2.35	2.48	2.40	2.20
Final weight	998	1011	1027	1003
Final score	4-Ch. 2-G	5-Ch. 1-G	6-Ch. 1-G	2-Ch. 2-G

Feedlot Performance (Havre)--Continued — Date: June 12, 1962

Breed	Hereford	Hereford	Hereford	Hereford
	Rancher IV	Rancher VI	Rancher VI	Line II
Line	× Line III		× Line II	169
Sex	Steer	Steer	Steer	Purebred steer
Number on test	6	5	6	4
Initial weight	455	365	396	344
Initial score	76.6	76.8	74.9	63.7
Days on test	238	264	260	253
Gain per head				
Total	596	559	581	630
Av. daily gain	2.51	2.11	2.24	2.47
Final weight	1051	824	977	974
Final score	4-Ch. 2-G	4-Ch. 1-G	3-Ch. 3-G	4-Choice

Feedlot performance for 1959-60 steers. Finished in 1961.

Montana Agricultural Experiment Station

Young Animals on Feed (Bozeman) — Date: June 12, 1962

	Hereford		Angus	
	Number individually fed	Number group fed	Number individually fed	Number group fed
Bulls	14		15	
Heifers		12		11
Steers		11		3

North Montana Branch Station

Young Animals on Feed (Havre) Date: June 12, 1962

	Hereford		
Purebred	Number individually fed	Number group fed	
Bulls	16		
Heifers		40	
Steers			
Grade			Rancher Grades
Bulls			Group Fed
Heifers	11	15	
Steers			36

Montana Agricultural Experiment Station (Bozeman)

Land, Physical Facilities, and Equipment Used

Item	Number	Actual cash value	Percentage used for breeding project
Beef barn and corrals	1 only	$18,500	60
Sheds	5 "	6,300	60
Irrigated land	200 acres	80,000	100
Saddle horses	2 only	300	60
Miscellaneous equipment	-	700	60
Total		$105,000	

North Montana Branch Station

Land, Physical Facilities, and Equipment Used (Havre) June 12, 1962

Item	Number	Actual cash value	Percentage used for breeding project
Bull barn	1 only	$15,750	75
Long shed	1 "	15,750	90
Home pasture	1,780 acres	25,830	90
Home farm land	200 "	5,400	85
Leased pasture	5,000 "	49,500	100
A. I. truck	1 only	1,530	75
Saddle horses	8 "	720	90
Scale & weigh house(station)	1 "	1,710	90
Scale & weigh house(lease)	1 "	630	100
Corrals at home station		2,700	90
Corrals at lease	-	1,350	100
Cattle squeeze	2 only	360	100
Cabins at lease	2 "	1,800	100
Automatic waterers	5 "	450	90

U. S. RANGE LIVESTOCK EXPERIMENT STATION

I. Station: U. S. Range Livestock Experiment Station, Miles City, Montana

II. Project Titles:

APH d1-1 Rev. The development and testing of methods of measuring performance in beef cattle

AH d1-1 (Rev. #2) Breeding crossing for increased production in beef cattle

AH d1-2 (Rev. #2) Development of superior lines of beef cattle

_____ Cooperative study of genetic-environmental interaction at Miles City, Montana, and Brooksville, Florida

III. Personnel:

U. S. Range Livestock Experiment Station, Miles City, Montana
Nat M. Kieffer and J. J. Urick

Office of Coordinator, Denver, Colorado
R. T. Clark, Coordinator, and J. S. Brinks

IV. and V. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

Project APH d1-1 Rev. The development and testing of methods of measuring performance in beef cattle

In the fall of 1960, 39 Herefords and 13 Charolais × Hereford steers were placed on postweaning gain test. These steers were fed on a weight-constant basis, and when a minimum of six steers reached a weight of from 1,000 to 1,050 pounds they were taken off test and slaughtered. The following two tables depict certain performance and carcass information by sire groups and by steer groups according to date of slaughter.

In May of 1961, ultrasonic estimates of ribeye area and fat depth were recorded for each of the 52 steers. The partial correlations (holding live weight constant) of the ultrasonic estimates with the actual carcass measurements were as follows: ultrasonic ribeye area and carcass ribeye area +.07, ultrasonic fat depth and carcass fat depth +.15, and ultrasonic ribeye area and fat depth -.04.

1960-61 R.O.P. STEERS - SUMMARY SHEET BY SIRE GROUPS

Trait and Number of steers	Heref. Sire No. 959	Heref. Sire No. 814	Heref. Sire No. 1020	Heref. Sire No. 8087	Heref. Sire No. 8088	Heref. Ch. Sire 861	Heref. Ch. Sire 9089
Number of steers	8	7	8	8	7	8	5
Initial weight	456	454	436	453	424	450	427
Days on test	229	230	231	239	243	218	224
Final weight	1029	1039	1020	1025	1026	1054	1020
24-hr. shrunk wt.	948	953	940	946	949	971	946
Chilled carcass wt.	600	597	591	590	594	620	593
ADG in feedlot	2.50	2.54	2.53	2.40	2.48	2.77	2.65
Slaughter grade[1]	12.50	12.57	12.25	10.75	9.71	14.75	16.80
Carcass grade	12.25	11.71	12.75	11.00	10.29	14.75	14.40
Length of body (mm)	1202	1194	1186	1188	1180	1205	1224
Length of fore-leg (mm)	341	335	331	335	321	351	355
Length of rear leg (mm)	734	730	718	727	721	760	743
Area of eye muscle (sq. in.)	12.27	12.52	11.55	11.30	11.96	12.46	12.00
Fat thickness over eye (mm)	16.40	15.87	19.45	22.11	20.14	16.13	14.66
Tenderness (W-B Shear)[2]	17.89	15.84	16.74	16.19	14.84	16.87	19.81
9-10-11 rib physical separation	%	%	%	%	%	%	%
Lean	28.12	28.49	26.58	25.11	26.16	29.53	28.04
Eye	17.14	16.35	16.44	15.33	14.63	17.44	18.81
Fat	36.73	37.81	40.72	43.35	42.77	34.89	35.16
Bone	15.91	15.62	14.99	14.98	14.89	16.15	16.35
Connective tissue	2.11	1.74	1.28	1.23	1.55	1.99	1.64

[1] 12 = Low Choice
10 = Medium Choice
8 = High Choice
14 = High Good
16 = Medium Good
18 = Low Good

[2] Numerical value = pounds pressure required to cut 1" core of meat. Low value most tender.

1960-61 R.O.P. STEERS - SUMMARY SHEET BY DATE OF SLAUGHTER

Trait	Slaugh. Group No. 1	Slaugh. Group No. 2	Slaugh. Group No. 3	Slaugh. Group No. 4	Slaugh. Group No. 5	Slaugh. Group No. 6
Date of slaughter	5-15-61	5-29-61	6-12-61	6-19-61	6-26-61	7-10-61
Number of steers	6	6	14	9	9	7
Initial weight	492	468	443	440	428	409
Days on test	200	214	228	235	242	256
Final weight	1041	1044	1032	1023	1023	1027
24-hr. shrunk wt.	975	957	949	950	940	943
Chilled weight	610	593	606	603	587	586
ADG in feedlot	2.75	2.69	2.59	2.47	2.46	2.33
Slaughter grade[1]	12.67	14.00	14.86	12.00	11.56	8.86
Carcass grade	15.00	13.67	13.29	12.00	10.67	10.00
Length of body (mm)	1233	1200	1202	1184	1190	1171
Length of fore-leg (mm)	345	337	345	339	335	318
Length of rear leg (mm)	722	734	746	736	728	719
Width of shoulders (mm)	212	213	211	212	208	212
Area of eye muscle (sq.in.)	10.77	11.59	12.27	12.79	12.64	11.04
Thickness of fat over eye (mm)	14.08	16.67	19.43	15.19	17.14	24.37
Tenderness (W-B Shear)[2]	17.43	16.45	18.21	18.23	14.97	14.06
9-10-11 rib physical separation	%	%	%	%	%	%
Lean	27.34	30.83	28.43	27.36	25.89	24.27
Eye	18.19	15.61	17.08	17.42	15.78	14.44
Fat	35.67	33.79	36.85	39.25	41.59	46.07
Bone	17.28	16.50	16.18	14.02	15.26	14.19
Connective tissue	1.52	3.36	1.63	1.44	1.48	0.94

[1]12 = Low Choice
10 = Medium Choice
8 = High Choice
14 = High Good
16 = Medium Good
18 = Low Good

[2]Numerical value = pounds pressure required to cut 1" core of meat. Low value most tender.

In June of this year, personnel from the Northern Great Plains Institute of Animal Reproduction, Topeka, Kansas, photographed the station's record-of-performance steers in three dimensions using stereo photography. Weights of the various standard beef cuts on the live animal will be computed from these photographs using the technique of photogrammetry. Weights of standard primal cuts of the steers will be obtained and correlations will be computed between actual weights of the various cuts and the weights of cuts estimated by the photogrammetry technique.

Project AH d1-1 (Rev. #2). Breed crossing for increased production in beef cattle

The first calves from interbreed crosses involving Hereford, Angus, Charolais, and Brown Swiss cows, and Hereford, Angus, and Charolais bulls were dropped this spring. The heaviest birth weights for an interbreed cross were recorded for the Charolais X Brown Swiss calves, and the heaviest within-breed birth weights were recorded for the Charolais calves. These crosses will be continued through the 1963 breeding season.

Project AH d1-2 (Rev. #2). Development of superior lines of beef cattle

1. Development of inbred Lines 11, 12, and 14 of Hereford cattle

Three lines of registered Hereford cattle presently under development at the U. S. Range Livestock Experiment Station were formed by crossing genetically diverse inbred lines. Line 11 was formed by making reciprocal crosses between Line 1 and Line 5. Line 12 was initiated by crossing Line 10 bulls and Line 1 cows. Line 14 was initiated by selecting cows from eight inbred lines and mating these cows to bulls representing eight different inbred lines. Inter se matings have been practiced in Line 12 for approximately 1.5 generations without any indication of a plateau having been reached for either preweaning or postweaning gains. Although inter se matings have been practiced for less than one generation in Lines 11 and 14, the results obtained thus far are encouraging. The 1961 birth weights and 180-day weaning weights for the three lines are presented below:

Line	Number of calves	Birth weight (lbs.)	180-day weaning weight (lbs.)
11	25	81.8	387.4
12	32	84.9	383.3
14	29	78.1	375.3

2. Crossline matings of inbred lines

The first calves from reciprocal crosses among Hereford inbred Lines 1, 4, 6, 9, and 10 were dropped this spring. A striking difference is evident in the conformation of calves resulting from the various line crosses. The line crosses will be continued through the 1963 breeding season.

3. Selection for carcass traits

The first group of steers from the group of cows in which selection is being practiced largely for carcass traits will be slaughtered in July of this year. All bull calves were left intact until weaning and four bulls were selected on the basis of their dam's index (constructed on the basis of carcass data of their steer progeny) for postweaning gain tests. One of these bulls is being used in the carcass herd during the current breeding season. In addition to obtaining carcass data according to past procedures, an attempt will be made this year to obtain the weights of the standard primal cuts.

Project_____ Cooperative study of genetic-environmental interaction at Miles City, Montana, and Brooksville, Florida

In the fall of 1961, a cooperative study of genetic-environmental interaction at Miles City, Montana, and Brooksville, Florida, was initiated with the shipment of 65 head of Line 1 cattle to Florida. At each location, 80 cows of Line 1 origin will be assigned to a group to be bred as a closed line at that location. Selection in each closed line will be for the same traits for a period of several generations. Also at each location, 20 cows equivalent genetically to those going into the closed herd will be put in a "control" herd in which they and their female descendants will be bred to bulls from the closed line at the other location. Thus, side by side, and maintained under the same management at each location will be a herd selected for performance at that location, and one which in effect has been selected for performance at the other. Comparisons of the performance of the two herds will be used as a measure of whether adaptation to a specific environment is an important factor in selection within a British beef breed.

A second population of 50 cows at each of the two locations of Miles City and Brooksville will be established by subdividing the present Hereford herd at the Brooksville station and sending half to Miles City. This subdivision will be accomplished in the fall of 1962, and the first Florida cattle should arrive at the U. S. Range Livestock Experiment Station in November of this year.

VI. Application of Findings

VII. Work Planned for the Future: To continue as outlined

VIII. Publications and Manuscripts:

Brinks, J. S., R. T. Clark, N. M. Kieffer, and J. R. Quesenberry
1962. Mature weight in Hereford range cows--Heritability, repeatability, and relationship to calf performance. J. Anim. Sci. 21(3):.

Brinks, J. S., R. T. Clark, N. M. Kieffer, and J. R. Quesenberry
1962. Genetic and environmental factors affecting performance traits of Hereford bulls. J. Anim. Sci. 21(4).

Brinks, J. S., R. T. Clark, and N. M. Kieffer
1962. Relationship of performance and ultrasonic measurements with certain carcass traits. (Abs. .) J. Anim. Sci. 21(3):.

Kieffer, Nat M., J. S. Brinks, R. L. Hiner, and R. T. Clark
1962. Comparison of straightbred and crossbred steers for certain performance and carcass traits. (Abs. .) J. Anim. Sci. 21(3):.

Shelby, C. E., W. R. Harvey, R. T. Clark, J. R. Quesenberry, and R. R. Woodward
1962. Estimates of phenotypic and genetic parameters in ten years of Miles City R.O.P. steer data. J. Anim. Sci.

Cattle Inventory — IX. PROJECT SUMMARY — Date: June 1962

Purebred — U. S. Range Livestock Experiment Station

Breed	H	H	H	H	H	H	H	H	C	B.S.	A
Line	1	4	6	9	10	11	12	14			
Station	U. S. Range Livestock Experiment Station										
Bulls, 12 mos. or over	21	6	3	5	5	4	4	5	4	0	0
Cows, 2 yrs. or over	153	32	32	43	37	46	55	54	71	42	59
Heifers, yearling	30	10	11	11	12	12	21	11	9	9	7
Steer calves						1			1		12
Bull calves	44	3	3	9	3	15	16	20	11	0	2
Heifer calves	46	2	1	1	3	14	17	23	9	0	7
Percentage used for breeding project	100	100	100	100	100	100	100	100	100	100	
Estimated cash value	$303,990 (total)										

H = Hereford; C = Charolais; B.S. = Brown Swiss, and A = Angus

Cattle Inventory--Continued IX. PROJECT SUMMARY Date: June 1962

Purebred U. S. Range Livestock Experiment Station

Breed	H	C.H.× C.H.	C×A	C×H	C × B.S.	A×H	A × B.S.	H × B.S.
Station	U. S. Range Livestock Experiment Station							
Bulls, 12 mos. or over	4							
Cows, 2 yrs. or over	175	26						
Heifers, yearling	56							
Steer calves	26	4	6	8	5	20	9	5
Bull calves	24	2	4	4	1	4	1	1
Heifer calves	42	4	20	15	4	19	3	3
Percentage used for breeding project	100	100	100	100	100	100	100	100
Estimated cash value	$74,715 (total)							

H = Hereford; C = Charolais, B.S. = Brown Swiss, and C.H. = Charolais × Hereford, A= Angus

Cattle Inventory--Continued IX. PROJECT SUMMARY Date: June 1962

Purebred U. S. Range Livestock Experiment Station

Breed	H	H	H	H	H	H	H	H	H	H
Line	1×4	1×6	1×9	1×10	4×6	4×9	4×10	6×9	6×10	9×10
Station	U. S. Range Livestock Experiment Station									
Bull calves	5	5	6	7	5	8	5	3	5	3
Heifer calves	7	5	4	2	5	3	4	5	5	7
Percentage used for breeding project	100	100	100	100	100	100	100	100	100	100

H = Hereford

U. S. Range Livestock Experiment Station

Cow Production Data — 1961 Calf Crop

Breed	Hereford	Hereford	Hereford
Line	1 (A.I.)*	1	4
Cows bred to calve as 2-yr.-olds	0	0	0
Calves born from 2-yr.-olds			
Alive	0	0	0
Dead	0	0	0
Cows bred to calve at 3 yrs. and up	88[1]	88[3]	25
Calves born from 3-yr.-olds and up			
Alive	59	72	18
Dead	4	1	2
All calves born			
Alive	59	72	18
Dead	4	1	2
Total	63[2]	73	20
Calves weaned	55	68	18
Percent calf crop			
Birth	76.8[4]	85.9	80.0
Weaning	67.1	80.0	72.0

	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	20	83.9	25	78.0	36	83.2	32	77.3	8	79.9	10	80.4
Weaning age		184.1		187.2		185.7		188.7		182.1		195.0
Weaning weight	20	390.1	25	383.8	36	397.4	32	374.7	8	349.6	10	386.9
Adjusted weaning weight - 180 days		383.2		369.6		387.9		360.7		345.6		364.1
Weaning score Condition and Conformation	20	73.3	25	73.2	36	74.7	32	70.5	8	74.5	10	76.1

*Artificially inseminated.

[1] Six cows sold after breeding season. Percentages computed on 82 remaining cows.

[2] Calves by cleanup bull included in cow production data but not in calf data.

[3] Three cows sold after breeding season. Percentages computed on 85 remaining cows.

[4] Percentage includes 10 calves by cleanup bulls.

Cow Production Data	1961 calf crop											
Breed	Hereford											
Line	6				9				10			
Cows bred to calve as 2-yr.-olds												
Calves born from 2-yr.-olds												
Alive												
Dead												
Cows bred to calve at 3 yrs. and up	23				33[2]				28[3]			
Calves born from 3-yr.olds and up												
Alive	22				26				22			
Dead	0				3				0			
All calves born												
Alive	22				26				22			
Dead	0				3				0			
Total	22[1]				29				22			
Calves weaned	21				22				20			
Percent calf crop												
Birth	95.7				90.6				81.5			
Weaning	91.3				68.8				74.1			
	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Birth weight	8	69.0	12	64.3	11	75.5	11	72.4	8	83.0	12	77.1
Weaning age		186.9		186.7		190.2		188.5		179.9		185.5
Weaning weight		350.5		362.7		379.2		373.4		352.0		356.6
Adj. weaning weight--180 days		340.8		351.6		362.1		359.6		350.8		348.5
Weaning score Condition and Conformation		74.5		73.3		72.5		72.1		70.8		70.9

[1]Calves by clean-up bulls are included in cow production data but are not included in calf data

[2]One cow sold after breeding season. Percentages computed on 32 remaining cows

[3]One cow sold after breeding season. Percentages computed on 27 remaining cows

U. S. Range Livestock Experiment Station

Cow Production Data (Continued) 1961 Calf Crop

Breed	Hereford	Hereford	Hereford
Line	11	12	14
Cows bred to calve as 2-yr.-olds	0	0	0
Calves born from 2-yr.-olds			
Alive	0	0	0
Dead	0	0	0
Cows bred to calve at 3 yrs. and up	36[1]	38[3]	40
Calves born from 3-yr.-olds and up			
Alive	27	32	34
Dead	2	2	2
All calves born			
Alive	27	32	34
Dead	2	2	2
Total	29[2]	34	36[2]
Calves weaned	25	32	30
Percent calf crop			
Birth	82.9	91.9	90.0
Weaning	71.4	86.5	75.0

	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	13	82.9	12	80.6	11	86.9	21	83.9	18	78.7	11	77.0
Weaning age		184.1		194.9		183.5		184.0		186.5		190.9
Weaning weight	13	398.8	12	408.3	11	399.1	21	384.9	18	398.3	11	372.3
Adjusted weaning wt. - 180 days		391.6		383.1		392.8		378.3		387.9		354.6
Weaning score Condition and Conformation	13	77.4	12	76.9	11	72.8	21	73.1	18	76.4	11	73.4

[1] One cow sold after breeding season. Percentages computed on 35 remaining cows

[2] Calves by cleanup bulls included in cow production data but not in calf data

[3] One cow sold after breeding season. Percentages computed on 37 remaining cows

U. S. Range Livestock Experiment Station

Cow Production Data (Continued) Date: June 1962

Breed	Hereford	Charolais	Brown Swiss
Line	Grade	0	0
Cows bred to calve as 2-yr.-olds	0	0	0
Calves born from 2-yr.-olds			
Alive	0	0	0
Dead	0	0	0
Cows bred to calve at 3 yrs. and up	150[1]	25	34
Calves born from 3-yr.-olds and up			
Alive	116	20	20
Dead	2	2	0
All calves born			
Alive	116	20	20
Dead	2	2	0
Total	118	22	20
Calves weaned	109	19	20
Percent calf crop			
Birth	79.2	88.0	58.8
Weaning	73.2	76.0	58.8

	Steers		Heifers		Bulls		Heifers		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	60	84.6	49	78.9	11	94.1	8	87.5	11	101.8	9	90.7
Weaning age		183.8		185.2		187.1		187.0		187.8		194.6
Weaning weight	60	426.3	49	397.3	11	537.5	8	490.5	11	568.4	9	557.6
Adjusted weaning wt. - 180 days		419.2		388.6		520.7		475.4		548.9		522.7
Weaning score Condition and Conformation	60	76.5	49	75.9	11	79.2	8	77.5	11	76.5	9	75.8

[1] One cow sold after breeding season. Percentages computed on 149 remaining cows

U. S. Range Livestock Experiment Station

Cow Production Data	1961 Calf Crop			
Breed	Charolais B[1]			
Line				
Cows bred to calve as 2-yr.-olds	0			
Calves Born from 2-yr.-olds				
Alive	0			
Dead	0			
Cows bred to calve at 3 yrs. and up	15			
Calves born from 3-yr.-olds and up				
Alive	13			
Dead	2			
All calves born				
Alive	13			
Dead	2			
Total	15			
Calves weaned	13			
Percent calf crop				
Birth	100.0			
Weaning	86.7			
	Steers		Heifers	
	No.	Av.	No.	Av.
Average:				
Birth weight	5	92.0	8	80.6
Weaning age		195.2		192.6
Weaning weight	5	488.8	8	451.0
Adj. weaning wt. - 180 days		457.9		426.7
Weaning score Condition and Conformation	5	73.8	8	75.6

[1] Cows in this herd were 1/2 Charolais, 1/2 Hereford; the breeding herd bull was a Charolais

U. S. Range Livestock Experiment Station

Feedlot Performance — Date: June 1962

Breed	Hereford	Hereford	Hereford	Hereford	Hereford
Line	1	4	6	9	10
Sex	Bull	Bull	Bull	Bull	Bull
Number on test	28	5	5	5	5
Average					
Age on test	194.4	194.2	200.0	202.2	192.0
Initial weight	443.3	378.8	375.8	407.2	404.6
Initial score					
Condition and					
Conformation	7.7	7.5	7.8	7.4	7.4
Days on test	196	196	196	196	196
Gain per head					
Total	516.0	505.4	466.8	492.8	477.4
Average daily gain	2.63	2.58	2.38	2.51	2.44
Efficiency of					
feed utilization					
Lbs. gain/100 lbs. TDN	21.96	23.01	22.13	22.50	21.64
Final weight	960.4	884.2	842.6	900.0	882.0
Final score					

Feedlot Performance (Continued) — Date: June 1962

Breed	Hereford	Hereford	Hereford	Char.	Hereford
Line	11	12	14		T-3 Grade
Sex	Bull	Bull	Bull	Bull	Bull
Number on test	9*	6	8	9	4
Average	192.6	195.0	195.9	195.0	199.0
Age on test					
Initial weight	426.9	457.2	448.5	569.1	467.5
Initial score					
Condition and					
Conformation	8.0	7.8	8.1	8.0	7.9
Days on test	196	196	196	196	196
Gain per head					
Total	500.8	560.3	503.9	511.0	508.0
Average daily gain	2.56	2.86	2.57	2.61	2.59
Efficiency of					
feed utilization					
Lbs. gain/100 lbs. TDN	21.89	24.20	21.59	20.21	21.63
Final weight	927.6	1017.5	952.4	1080.1	975.5
Final score					

*One bull removed from test; average computed on 8 bulls

U. S. Range Livestock Experiment Station

Young Animals on Feed — Date: June 1962

	Hereford		Charolais	Brown Swiss
Purebred	Number individually fed	Number group fed	Number individually fed	Number group fed
Bulls	70		9	
Heifers				
Steers				
Grade				
Bulls	4			
Heifers				
Steers		39		8

Land, Physical Facilities, and Equipment Used — Date: June 1962

	Actual cash value	Percentage used for breeding project
Land	$ 812,500	92
Buildings, corrals, land improvements, fence, and residences, etc.	2,500,000	92

UNIVERSITY OF NEVADA

I. Station: Nevada Agricultural Experiment Station, Reno, Nevada

II. Project Title: The effect of environment on selection for traits of economic importance, the value of several selection criteria, and reproduction studies in range beef cattle (Project 304 W-1).

III. Personnel:

Experiment Station:

C. M. Bailey, F. H. Gilbert, J. E. Hunter, C. R. Torell, and W. D. Foote

U. S. Department of Agriculture, Agricultural Research Service:

R. T. Clark, Coordinator, and J. S. Brinks

IV. and V. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

Analysis of Performance Test Data

Data obtained from calves performance tested for 140 days during the period 1956 to 1961 were analyzed in cooperation with the Regional Coordinator's Office.

Data for each location were analyzed separately. Least squares procedures were used for calculating constant estimates and tests of significance. Effects included in the model for all traits except gain/cwt. TDN were: line, year, sex, age-of-dam, and initial age. Age-of-dam was treated as a discrete variable. Initial age was an independent, continuous variable. The model for gain/cwt. TDN was similar but initial weight was an independent, continuous variable instead of initial age. Interactions were assumed to be of negligible importance.

Calves tested at Reno averaged 255 days in age at the beginning of the tests. Calves at Contact were one week younger. Means, standard deviations, estimates of effects, and mean squares are given in tables 1, 2, and 3.

Table 1.--Means and standard deviations of the unadjusted data according to location

Trait	Reno			Contact		
	No.	Mean	S.D.	No.	Mean	S.D.
Initial weight, lbs.	315	485	57	150	380	50
Gain on test, lbs.	315	234	59	150	156	37
Final weight, lbs.	315	719	88	150	535	59
Gain/cwt. TDN, lbs.	315	19	3	150	18	4
Conformation[a]	315	83	2	112	83	2

[a]Scores from 100 (outstanding) to 67 (cull). Calif. Agr. Ext. C. 451, dated 1956.

Table 2.--Estimates of the effects of line, year, sex, age of dam, and initial age or weight on performance traits according to location

Effect	Initial weight (lbs)		Gain on test (lbs)		Final weight (lbs)		Gain/cwt.TDN (lbs)		Conformation[1]	
	Reno	Contact	Reno	Contact	Reno	Contact	Reno	Contact	Reno	Contact
Line										
Rate of gain	2.6	-3.9	2.4	0.8	5.0	-3.1	0.2	0.1	0.1	0.0
Economy of gain	-0.9	3.9	5.7	-0.8	4.9	3.1	0.4	-0.1	-0.2	0.0
Conformation	-1.7	....	-8.2	....	-9.9	....	-0.5	....	0.0	....
Year										
1957	-7.5	....	4.4	....	-3.1	....	-0.3	....	-2.7	....
1958	13.0	-29.2	-64.1	22.2	-51.0	-6.9	-3.6	2.8	-0.1	-1.4
1959	-9.9	-1.7	16.9	-31.7	7.0	-33.3	1.8	-2.6	0.4	....
1960	16.0	31.8	-1.9	-26.9	14.2	4.9	-0.6	-2.4	0.6	0.2
1961	-11.7	-0.9	44.7	36.4	32.9	35.3	2.1	2.2	1.8	1.2
Sex										
Bull	22.4	10.4	38.2	13.0	60.6	23.4	2.2	1.1	-0.4	-0.4
Heifer	-22.4	-10.4	-38.2	-13.0	-60.6	-23.4	-2.2	-1.1	0.4	0.4
Age of dam										
3	-23.3	-26.4	3.0	0.6	-20.3	-25.8	-0.1	0.1	-0.3	-0.3
4-5	-1.5	4.7	-0.2	5.2	-1.7	9.9	0.2	0.2	0.3	0.1
6-8	15.7	12.1	-1.3	0.5	14.4	12.7	0.2	0.1	0.1	0.3
9[2]	9.1	9.6	-1.5	-6.3	7.6	3.2	-0.2	-0.3	-0.1	-0.1
Initial age										
Effect of 1 day	1.34	1.28	-0.14	0.04	1.20	1.32	....	....	0.02	0.02
Initial weight										
Effect of 1 pound	....	....	....	....	....	....	-0.02	-0.02	....	....

[1]Scores from 100 (outstanding) to 67 (cull). Calif. Agr. Ext. Circ. 451, dated 1956.

[2]This group includes dams 9 years of age and older

Table 3. Mean squares for performance traits according to location

Source of variation	Initial weight		Gain on test		Final weight		Gain/cwt.TDN		Conformation	
	Reno	Contact	Reno	Contact	Reno	Contact	Reno	Contact	Reno	Contact
Line	500	2,104	5,393**	90	7,291	1,315	23**	1	3	0
Year	10,718**	17,697**	90,736**	44,047**	54,274**	25,065**	319**	293**	142**	45**
Sex	152,467**	14,756**	440,555**	22,906**	1,110,718**	74,604**	1,318**	159**	45**	12*
Age of dam	17,897**	5,688*	216	673	14,333**	6,062*	3	1	4	1
Independent variable[a]	120,136**	74,811**	1,380	72	95,664**	79,488**	269**	120**	16	12*
Error	2,205	1,756	914	298	2,984	2,083	4	4	5	3

[a]Initial age was the independent variable for all traits except gain/cwt.TDN. Initial weight was the independent variable for gain/cwt.TDN.

*P<.05
**P<.01

Environmental factors studied generally were consistent in importance for the two locations, despite differences in magnitude. Line differences in performance traits were significant ($P<.01$) at Reno only. Calves produced in the line in which conformation was the criterion for selection tended to gain at a slower rate and were less efficient than calves from lines in which selection was practiced for rapid gain or efficient feed conversion. Within locations, calves from the rate-of-gain and economy-of-gain lines appeared to be similar in performance.

Digestibility Trial

Digestibility trials were completed at both locations during the 1960-61 test. An approximation technique (percent lignin in feed and feces) was used for estimating TDN. Data for each location were analyzed separately. TDN values obtained from the trial were much the same as figures compiled from the literature. Line differences in digestibility of feeds were non-significant. TDN values for females exceeded those for males (5.7%*) at Reno only.

Blood Samples

Blood samples were drawn from calves tested at Reno during 1961-62. Serum alkaline phosphatase, blood urea, and plasma fat were determined.

Carcass Data

Rib cuts from bulls tested at Reno (which were not retained for breeding) during 1959-60 and 1960-61 were physically separated into components of fat, lean, and bone. A limited amount of carcass information was obtained from bulls culled following completion of the 1961-62 test at Reno.

VI. Application of Findings:

Range herd improvement was discussed in a talk given at the Annual Field Day at the Knoll Creek substation.

Information from the study of performance test data will be useful in plotting the direction of the breeding project and in determining adjustment factors for performance test records.

VII. Work Planned for the Future:

Plans are being made for a project revision.

Blood data have been collected for two years. Relationships of blood constituents with production traits will be studied before any further data of this type are obtained.

Carcass data will be obtained from reject bulls as appropriate.

VIII. Publications and Manuscripts

Bailey, C. M., and F. H. Gilbert
1962. Factors affecting performance traits of Hereford calves in lines developed in two environments. Amer. Soc. Anim. Sci. West. Sect. Proc. 13:XXII.

IX. PROJECT SUMMARY

Cattle Inventory

Purebred

Breed	Hereford	Hereford	Hereford	Hereford	Hereford
Line	R_1 Reno	R_2 Reno	R_3 Reno	K_1 Knoll Creek	K_2 Knoll Creek
Bulls 12 mos. or over	6	6	5	6	6
Cows 2 yrs. or over	31	31	30	31	31
Heifers, yearlings	6	7	5	6	5
Bull calves	7	13	15	15	16
Heifer calves	17	16	13	13	9
Percentage used for breeding project	100	100	100	100	100
Estimated cash value	$14,350	$15,050	$13,800	$14,750	$14,250

Cow Production Data — 1961 calf crop

Breed	Hereford											
Line	R_1				R_2				R_3			
Cows bred to calve as 2-yr.-olds												
Cows bred to calve at 3-yrs. and up	29				33				30			
Calves born												
Alive	28				26				26			
Dead	1				0				1			
Total	29				26				27			
Calves weaned	27				25				24			
Percent calf crop[1]												
Birth	97				79				87			
Weaning	93				76				80			
	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Weaning age, days		225		219		230		232		230		218
Weaning weight, lbs.	13	458	12	406	11	497	14	424	15	469	9	403

Line	K_1				K_2			
Cows bred to calve as 2-yr.-olds								
Cows bred to calve at 3 yrs. and up	28				27			
Calves born								
Alive	21				21			
Dead	2				0			
Total	23				21			
Calves weaned	20				21			
Percent calf crop[1]								
Birth	75				78			
Weaning	71				78			
	Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Weaning age, days		221		230		222		216
Weaning weight, lbs.	7	371	12	381	10	402	10	340

[1] $\frac{\text{Calves born alive}}{\text{Cows exposed to bull}} \times 100$ $\frac{\text{Calves weaned}}{\text{Cows exposed to bull}} \times 100$

Feedlot Performance

Breed	Hereford					
Line	R_1		R_2		R_3	
Sex	Bulls	Heifers	Bulls	Heifers	Bulls	Heifers
Number on test	13	12	11	14	15	9
Average:						
Age on test, days	251	245	256	258	256	244
Initial weight, lb.	463	416	506	425	457	408
Initial score Conformation[1]	84	84	85	85	85	85
Days on test	140	140	140	140	140	140
Gain	276	186	269	187	254	181
Av. daily gain	1.97	1.33	1.92	1.34	1.81	1.29
Efficiency Lbs.gain/100 lbs.TDN	22.7	16.5	20.7	16.9	21.3	16.4
Final weight	739	602	775	612	712	588
Final score Conformation[1]	84	84	84	85	85	86

Line	K_1		K_2	
Sex	Bulls	Heifers	Bulls	Heifers
Number on test	7	12	10	10
Average				
Age on test, days	239	248	240	234
Initial weight, lbs.	381	390	417	352
Initial score Conformation[1]				
Days on test	140	140	140	140
Gain	162	136	164	129
Av. daily gain	1.16	0.97	1.17	0.92
Efficiency Lbs. gain/100 lbs.TDN	15.8	13.8	16.1	14.4
Final weight, lbs.	543	526	581	481
Final score Conformation[1]	84	83	83	84

[1]Calif. Agr. Est. Circ. 451, dated 1956.

Nevada Agricultural Experiment Station

Young Animals on Feed — Date: June, 1962

Purebred 1961-62

	Number individually fed	Number group fed
Bulls	56	0
Heifers	57	0
Steers	0	0

Nevada Agricultural Experiment Station

Land, Physical Facilities, and Equipment Used — Date: June 1962

Item	Number	Actual Cash Value	Percentage Used For Breeding Project
Reno Station:			
Land, buildings, etc.	1 only	$350,000	20
Knoll Creek Station	1 only	100,000	60
Laboratories	1 only	100,000	30

UNIVERSITY OF NEVADA

I. Station: Nevada Agricultural Experiment Station, Reno Nevada

II. Project Title: The effect of genetic-environmental interactions on selection responses (Project 390 W-1).

III. Personnel:

Experiment Station:
C. M. Bailey, H. J. Weeth, and F. H. Gilbert

U. S. Department of Agriculture, Agricultural Research Service:
R. T. Clark, Coordinator, and J. S. Brinks

IV. and V. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

Switched Ration Experiment

Data from generations seven and eight of the rat selection study in which rats were fed either the "regular" or a "switched" ration were analyzed. Separate analyses were performed for each sex-generation group. Means of 70-day weights are given in table 1. Mean squares are presented in table 2.

Table 1.--Means for 70-day body weight (gram) according to generation, sex, mixture fed during the performance test, and line of origin

Generation and sex	Fed concentrate mixture during test		Fed roughage mixture during test	
	SS[a]	RS	SS	RS
Generation seven				
Males	270.9	298.8	234.7	245.8
Females	206.3	209.0	192.9	202.2
Generation eight				
Males	259.2	218.8	193.3	197.6
Females	179.8	172.9	169.2	175.7

[a]Indicates line of origin. SS rats were from lines maintained on a concentrate mixture. RS rats were from lines fed 65% concentrate: 35% ground alfalfa during the performance test. Selection was practiced for 170-day weight in both parent lines.

Table 2.--Mean squares for 70-day body weight by generation and sex [a]

Source of variation	Generation seven males	Generation seven females	Generation eight males	Generation eight females
Ration	47450**	2585**	37715**	119
Line	10025*	913	6532*	0
Ration × line	1658	287	9991**	733
Error	1583	344	1108	431

[a] N = 361
*P < .05
**P < .01

Rats from lines in which selection had been practiced for 70-day weight under good feeding conditions (concentrate only) were not consistently superior in body weight at 70 days of age to rats from lines selected under poor feeding conditions (high roughage during the performance test) when both groups were fed the concentrate mixture. Rats from lines selected under poor feeding conditions exceeded in weight rats from lines selected under good feeding conditions when both groups were fed the high roughage ration. However, the line × ration interaction was significant in only one of the four analyses.

Project Revision

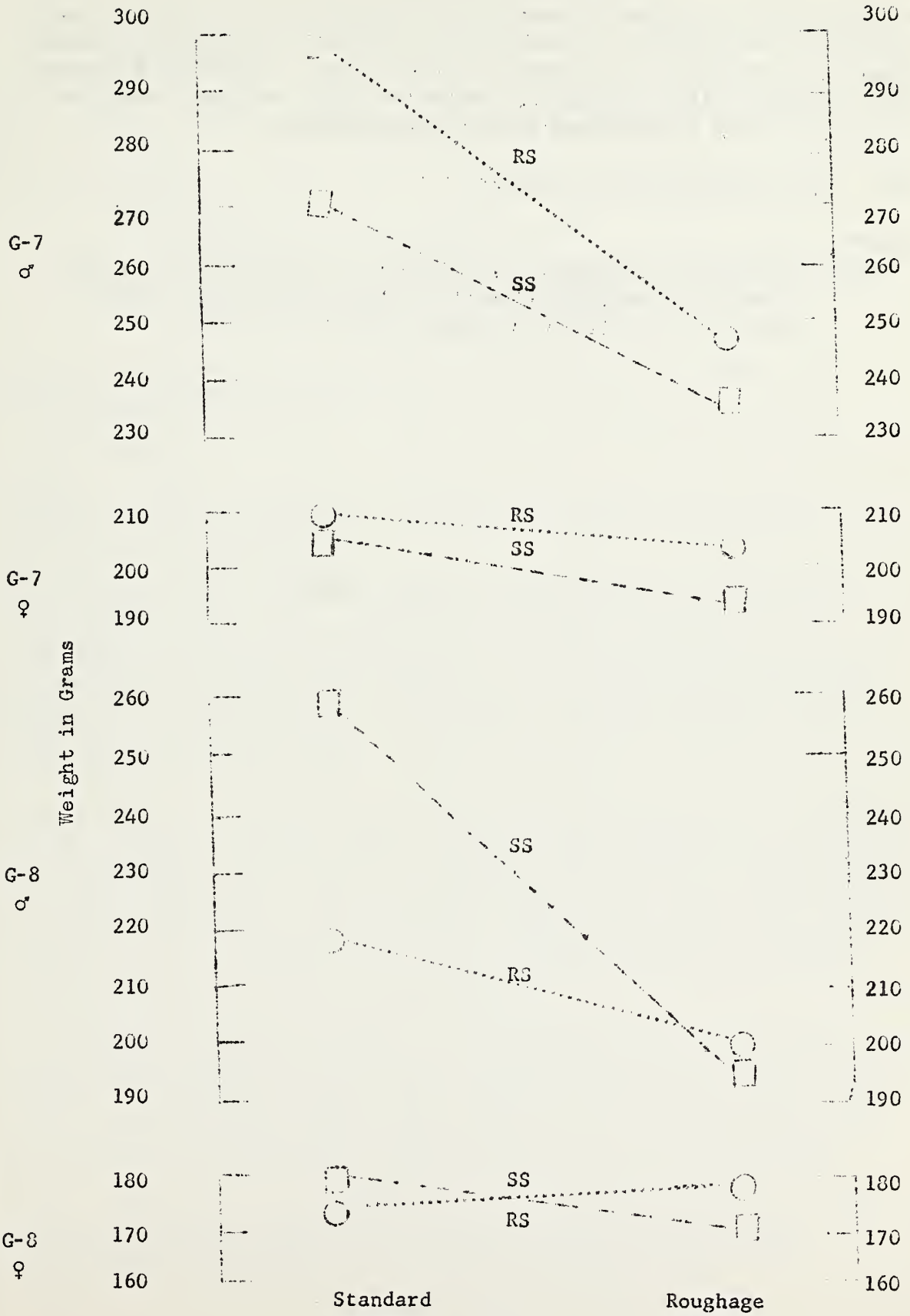
The initial phase of the project was terminated due to a high incidence of sterility, especially in the line selected for size on the high plane of nutrition. A new phase of the project designed to test selection responses and fertility levels of rats maintained on a roughage mixture throughout their lifetime, or on a concentrate mixture except during the period just prior to breeding, has been started. Rats from four highly inbred lines have been obtained. These are:

Line Designation	Source
Fischer 344	University of Miami
ACI/N	National Institutes of Health
M520/N	National Institutes of Health
Nevada Hooded	University of Nevada

VI. Application of Findings:

Although not clear-cut, there is some indication that differential growth may occur among stocks with histories of selection under different feeding conditions, when comparisons are made in a poor nutritional environment. This may be of value in planning beef cattle work, such as topcross tests, for assessing the importance of genotype × environment interactions.

Means for 70-day body weight for rats
tested on standard or roughage rations



VII. Work Planned for the Future:

Analysis of data obtained to date will be completed. The number of rats in each of the four inbred lines will be expanded. All possible combinations of matings will be made among the four lines. Following a four-way cross, progeny will be assigned at random to eight sublines. Selection will be practiced as described in the project outline.

VIII. Publications and Manuscripts:

Gilbert, F. H.
1962. The effect of exchange of environment on body weights of rats from lines selected under two nutritional regimes. M. S. Thesis. University of Nevada, Reno

NEW MEXICO STATE UNIVERSITY

I. Station: New Mexico Agricultural Experiment Station, University Park, New Mexico

II. Project Title: Breeding beef cattle for Southwestern ranges

III. Personnel:

Experiment Station:
L. A. Holland, J. H. Knox, and E. E. Ray

U. S. Department of Agriculture, Agricultural Research Service:
R. T. Clark, Coordinator, and J. S. Brinks

IV. and V. Nature and Extent of Work Done This Year and Summary of Progress and Conclusions to Date:

Vaginal Prolapse

Analysis of data for the vaginal prolapse study was completed and a manuscript is being prepared.

The data were from records of disposal of cows from the purebred and grade herds at NMSU. The purebred herd has been closed to outside breeding since 1932 with the exception of one bull introduced in 1940 and has been kept under farm conditions. The grade herd has been maintained on the College Ranch. The two herds are believed to be similar genetically because the purebred herd has produced all the bulls used in the grade herd since 1935.

Vaginal prolapse was expressed in the purebred herd but was not expressed in the grade herd nor among some purebred heifers transferred at yearling age to the ranch. The trait was expressed just prior to or immediately following parturition. Therefore, only those cows that produced at least one calf were included in the analysis. The number of cows in the different groups were purebred herd, 150, grade herd, 400, and purebreds transferred to the ranch at yearling age, 22.

The environments differed greatly. The purebred cattle on the farm were kept on a higher plane of nutrition, had less exercise, were calved first as two-year-olds rather than as three-year-olds, were calved year round rather than only in the spring, and were not automatically culled for age at nine or ten years of age as were the cattle on the ranch.

Vaginal prolapse was the primary reason for disposal of 27 of the 150 cows born since 1931 which have produced at least one calf before leaving the purebred herd.

Table 1. Number of Cows Leaving the Purebred Herd for Various Reasons

Primary reason for disposal	n	Age in months
Death	16	67
Cancer eye	15	120
Vaginal prolapse	27	68
Other than death, cancer eye, or vaginal prolapse	92	73
Total	150	

Seven other cows also exhibited prolapse, two of which were culled because of cancer eye and five which left the herd for reasons other than death, cancer eye, or vaginal prolapse.

The trait was variable not only in age at which first expressed but also in severity of expression. That death did not result from the condition may be partly explained by the practice of removing from the herd those cows which expressed the trait in severe form.

The tendency of some bulls to sire daughters with a high incidence of vaginal prolapse suggested that susceptibility might be heritable. However, it was recognized that some sires' progenies tended to be culled at younger ages than others and accordingly might not have equal opportunity to express the trait. Therefore, scores for susceptibility to prolapse based on the assumption that susceptibility is normally distributed were derived from the numbers shown in Table 2.

Heritability estimates after scoring individuals for susceptibility were by paternal half sib correlation method, .57, and intra-sire regression of daughter on dam, .14.

Selection practiced against prolapse in the "old" line since 1953 apparently has not been effective, the percentage incidence of prolapse in it being greater than in the "outcross" line. This difference is not statistically significant.

Table 2. Number of Cows Leaving the Purebred Herd at Various Ages and Scores for Susceptibility to Vaginal Prolapse

Age at leaving the herd	Prolapse		Susceptibility scores	
	Yes	No	Prolapse	No prolapse
2	1	6	23	3
3	2	17	20	3
4	9	21	17	3
5	1	13	14	3
6	8	13	13	2
7	2	6	11	2
8	2	14	10	2
9	4	3	9	1
10	0	9	7	1
11	1	6	7	1
12	1	3	7	1
13	2	1	5	1
14	1	3	4	0
17	0	1		
Total	34	116		

Analysis of Live Animal and Carcass Data

Some progress was made in tabulating and analyzing these data. Live animal and carcass data were obtained on 24 steers making data available on a total of 122 steers.

VI. Application of Findings:

Expression of vaginal prolapse in one environment but not in another further substantiates the contention that selection of breeding animals should be made within the environment in which their offspring are expected to live and reproduce. Selection against vaginal prolapse cannot change the percentage incidence rapidly, even if heritability is as high as the 57% estimated by one method because selection of bulls must be based on phenotypes of female relatives thus halving effective heritability of the trait. Generation interval will be lengthened because bulls will tend to be selected from older cows.

VII. Work Planned for the Future:

The analysis of live animal and carcass data now underway should be completed.

VIII. Publications and Manuscripts:

Blackwell, R.L., J. H. Knox, C. E. Shelby and R. T. Clark. 1962. Genetic analysis of economic characteristics of young Hereford cattle. J. Anim. Sci. 21:101

Holland, Lewis A. 1962. Hydrocephalus. Cattle Breeders' School Breeding for Beef. Mimeographed. p. 11

Ray, Earl E. 1962. Relationships between live and carcass traits. Cattle Breeders' School Breeding for Beef. Mimeographed. p. 21.

Knox, J. H. 1962. Selection for carcass merit. Cattle Breeders' School Breeding for Beef. Mimeographed. p. 29.

IX. PROJECT SUMMARY

Cattle Inventory

Purebred	Hereford	Hereford
	Old Main	Outcross Main
Bulls 12 mos. or over	12	2
Cows 2 yrs. or over	36	15
Heifers, yearlings	16	8
Bull calves	14	6
Heifer calves	18	7
Percentage used for breeding project	80	80
Estimated cash value	$29,100	$10,850

Grade Breed	Hereford
Station	Main
Bulls 12 mos. or over	
Cows 2 yrs. or over	92
Steer calves	32
Heifer calves	33
Percentage used for breeding project	50
Estimated cash value	$24,850

Cow Production Data

Breed	Hereford					
Line	Old			Outcross		
Cows bred to calve as 2-yr.-olds	10			2		
Calves born from 2-yr.-olds						
Alive	7			2		
Dead	3			0		
Cows bred to calve at 3 yrs. and up	22			10		
Calves born from 3-yr.-olds and up						
Alive	20			9		
Dead	1			1		
All calves born						
Alive	27			11		
Dead	4			1		
Total	31			12		
Calves weaned	25			10		
Percent calf crop[1]						
Birth	97			100		
Weaning	78			83		
	Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.
Birth weight	13	78	2	81	16	73
Weaning age		240		240		240
Weaning weight--240 da.	8	575	2	492	15	479
Weaning score						
Condition		11.0		6.5		9.3
Conformation		7.0		6.0		6.5
	Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.
Birth weight	3	69	2	59	7	64
Weaning age		240		240		240
Weaning weight--240 da.	2	548	2	262	6	446
Weaning score						
Condition		11.5		2.5		10.3
Conformation		7.0	1	6.0		7.0

[1]Percent calf crop - birth $= \frac{\text{number live + dead calves at birth}}{\text{number of cows bred}} \times 100$

Percent calf crop - weaning $= \frac{\text{number of calves weaned}}{\text{number of cows bred}} \times 100$

Cow Production Data

Breed	Hereford			
Line	Grade			
Cows bred to calve as 2-yr.-olds				
Cows bred to calve at 3 yrs. and up	85			
Calves born				
Alive	47			
Dead	3			
Total	50			
Calves weaned	46			
Percent calf crop[1]				
Birth	58.8			
Weaning	54.1			
	Steers		Heifers	
	No.	Av.	No.	Av.
Adj. weaning weight - 205 days	18	399	28	361
Weaning score Conformation		7.22		6.89

[1]Percent calf crop - birth = $\frac{\text{number of live + dead calves at birth}}{\text{number of cows bred}} \times 100$

Percent calf crop - weaning = $\frac{\text{number of calves weaned}}{\text{number of cows bred}} \times 100$

Feedlot Performance — N. Mex. Agricultural Experiment Station

Date: Completed test in calendar year 1961

Breed	Hereford	Hereford
Line	Old	Outcross
Sex	Bull	Bull
Number on test	11	3
Average:		
Age on test	10 months	10 months
Initial Weight	635	631
Initial score:		
Condition		
Conformation		
Days on test	140	140
Gain		
Total	307	306
Average daily gain	2.19	2.18
Efficiency of feed utilization		
lbs. TDN/100 lbs. gain or lbs. gain/100 lbs. TDN	474	491
Final Weight	942	906
Final score:		
Condition		
Conformation		

Young Animals on Feed

Purebred Breed	Hereford	
	Number individually fed	Number group fed
Steers		18

Land, Physical Facilities, and Equipment Used

N. Mex. Agricultural Experiment Station

Date: June 1962

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Range land	63,000 acres	$189,000	33
Farm land	52 acres	52,000	33
Feed lots		30,000	50
Barns	2 only	120,000	70
Meat laboratory	1 only	100,000	10
Pathology laboratory	1 only	40,000	15
Calculators	4 only	28,000	60
Office equipment		600	60

OREGON STATE UNIVERSITY

I. Station: Oregon Agricultural Experiment Station, Corvallis Oregon

II. Project Title: Improvement of beef cattle through breeding methods using basic physiological differences in rate and efficiency of gains.

III. Personnel:

Oregon State University:

Experiment Station:

Central Station, Corvallis:

Ralph Bogart, Leader, Walter Kennick, A. T. Ralston, and D. C. Church

Statistics Department:

L. D. Calvin

Food Science and Technology:

Al Anglemier, W. K. Johnston, Franklin Ampy, Frank Hoornbeck, and Lloyd Westcott

Squaw Butte-Harney Range and Livestock Station, Burns:

W. A. Sawyer, Joe Wallace

Eastern Oregon Branch Station, Union:

James McArthur

Malheur Branch Station, Ontario:

E. N. Hoffman

John Jacob Astor Branch Station, Astoria:

H. B. Howell

U. S. Department of Agriculture, Agricultural Research Service:

R. T. Clark, Coordinator, and J. S. Brinks

IV. and V. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

Objectives

1. The growth pattern of calves differing in rate and efficiency of gains and according to sex, line and year

2. The relation of nitrogenous and carbohydrate constituents of the blood and urine to rate and efficiency of gains

3. The relation of blood enzymes to rate and efficiency of gains

4. Selection for greater rate and efficiency of gains on a ration composed primarily of roughage

5. The development and use of inbred lines

6. Testing bulls of the inbred lines on commercial cows to determine their value as sires of good-doing calves that make desirable carcasses

7. The inheritance of the tendency for chronic bloating

8. The interaction of inheritance and nutrition (or other environmental factors) in causing abnormalities

9. The use of physiological studies in establishing or assisting in development of reliable indices for beef cattle improvement

10. Influence of inbreeding on performance traits

11. Determine relationship between certain physiological factors and carcass value

Major Results of the Year

1. In cooperation with Dr. R. T. Clark and Dr. James Brinks of the Regional Coordinator's office the records for Project 1 have been coded and punched on IBM cards. Three different sets of cards have been punched to include the information necessary to support the following studies which have been analyzed and are being written for publication

Study 1. Factors affecting feed consumption, rate of gain, and feed efficiency in cattle and the relationship between the above-mentioned traits

a. $Y_{ijk} = \mu + \text{sex 1} + \text{sex 2} + \text{line 1} + \text{line 2} + \text{line 3} + \text{line 4} + \text{age} + \text{year} + \text{inbreeding of calf} + E_i$

Y_i = feed consumption,
Y_j = rate of gain
Y_k = feed efficiency

The 300-pound feed test period has been broken into four 75-pound subperiods and each of the models given will be fitted for each period. Correlations have been determined between each period and all succeeding periods for (1) feed consumption, (2) feed efficiency, and (3) rate of gain. The correlations were run also between each of these variables within each period and among all succeeding periods.

Study 2. The relative importance of various factors affecting feed consumption in six 28-day periods immediately following weaning

The model for this study is

$$Y_i = \mu + \text{sex 1} + \text{sex 2} + \text{line 1} + \text{line 2} + \text{line 3} + \text{line 4} + \text{inbreeding of calf} + \text{year} + E_i$$

Y = feed consumption
i = period 1, 2, 3, 4, 5, and 6

Study 3. A comparison of the correlations between pre- and post-weaning gains when corrected and uncorrected values are used. This study determines whether inbreeding depression during the suckling period is compensated for in the post-weaning period.

The models for this study are

a. $$Y_{ij} = \mu + \text{sex 1} + \text{sex 2} + \text{line 1} + \text{line 2} + \text{line 3} + \text{line 4} + \text{inbreeding of dam} + \text{inbreeding of calf} + \text{age of dam} + \text{year} + E$$

This model has been used for an analysis of both suckling gain and gain on test. Therefore,

Y_i = suckling rate of gain per day
Y_j = gain per day on test

b. $$Y_{ij} = \mu + \text{sex 1} + \text{sex 2} + \text{line 1} + \text{line 2} + \text{line 3} + \text{line 4} + \text{inbreeding of dam} + \text{age of dam} + \text{year} + E$$

In this model the inbreeding of the calf is omitted. An analysis of both suckling rate of gain and rate of gain on test have been run using this model.

Individual corrections are made for each animal using the elements of Model 1 as correction factors. Correlations between the corrected rate of gain for suckling and test periods have been

determined. Individual corrections have been made using the elements of Model 2 and correlations between the corrected values for suckling rate of gain and rate of gain on test have been determined. The correlations in this case are made with respect to inbreeding of calf. The animals are divided into three classes on the basis of their inbreeding, namely:

0 - 10%
11 - 20%
> 20%

Correlations between uncorrected values for suckling rate of gain and rate of gain on test also have been determined.

Comparison of correlation 1 with correlation 3 should show whether or not compensation for depressed suckling gain is occurring.

Comparison of correlation 1 with correlation 2 should show whether there is compensation during the feed test period for inbreeding depression during the suckling period. A comparison of correlation 2 at the three levels of inbreeding should give further evidence as to whether genetic depression in one phase of the life cycle results in compensation in another phase of the life cycle.

Study 4. A determination of the time during the suckling period at which inbreeding of the calf has its most severe effect

Model

$$Y_i = \mu + \text{sex 1} + \text{sex 2} + \text{line 1} + \text{line 2} + \text{line 3} + \text{line 4} + \text{age of dam} + \text{year} + \text{inbreeding of dam} + \text{inbreeding of calf} + E$$

Calculations have been made of the total gain in each of six 28-day periods starting with birth. Inbreeding is broken into the following discrete levels: 0-5, 6-10, 11-15, 16-20, 20-25, and > 25.

Y = gain in any particular (ith) period
i = periods 1, 2, 3, 4, 5, and 6

The analysis has been run for each period.

Study 5. Correlations between gain in weight of calf and change in weight of cow for each of the six periods have been determined. This should give information on effect of weight changes in dam in any period upon amount of gain of the calf in that period and all succeeding periods.

2. Data have been gathered on 59 Hereford and 37 Angus calves over a two-year period and now are being analyzed for the following blood constituents or characteristics:

Urea nitrogen
Protein nitrogen
Specific gravity
Serum albumin
Serum alpha globulin
Serum beta globulin
Serum gamma gloublin

The relation of these blood factors to rate of gain has been studied at various stages of preweaning and postweaning growth and to feed efficiency at various stages of postweaning growth. The effects of lines, sexes, and years have been estimated to ascertain the relative effect of genetics and environment on these traits.

There has been some evidence to show that relationships do exist between the nitrogenous constituents of the blood and growth and development. However, the data have not been consistent enough for stating definitely that it could be used as indices for predicting future performance. Perhaps if these constituents (nitrogenous) cannot be used as indices for future performance they will give information on relationships that exist among them and possibly some information on the chemistry of bovine blood serum.

3. Bulls from four inbred lines of beef cattle were mated to grade cows during a three-year study for comparisons in performance and carcass traits and for studies on the relations among traits. The traits considered were final weight, daily gains, carcass conformation, marbling score, USDA grade, and percentage fat in the carcass. The effects of lines, years, age of dam, birth date, birth weight, weaning age, suckling gains, weight on feed, type, and condition on the other traits were estimated by analyzing by least squares. Correlation coefficients of the traits were determined. Bulls of one line sired calves that were the most rapid in rate of gain and had the largest final and carcass weights. Bulls from a second line sired calves that excelled in marbling, carcass conformation, and were highest in percentage fat of the carcass. The bulls from the third line sired calves that excelled in USDA grade and in dressing percentage. The bulls from the fourth line were inferior in all respects. Even though there were significant year and year X line of sire

effects the differences between lines were well established. The relationship of performance within the lines to the performance of their top-cross progeny showed general agreement in that the line having the best conformation sired top-cross progeny highest in carcass conformation and marbling. Also, the line having the highest rate of gain sired top-cross progeny with the greater rate of gain. Type and condition scores were not indicative of good performance or carcass characteristics. Also, marbling was not related to percentage fat in the carcass. Heavier final weights were associated with higher dressing percentages, carcass conformation scores, and percentage fat in the carcasses. USDA grade, dressing percent, marbling, and carcass conformation were all positively associated. In addition, the following were positively associated: dressing percent with fat percent of carcass, marbling with carcass conformation, and carcass conformation with percent fat of the carcass.

4. In cooperation with Drs. Clark and Brinks, the data from Squaw Butte have been punched and are being analyzed as four studies:

a. The relation of winter gains under two levels of feeding to gains the following summer within each level of winter feeding. Do good gaining cattle express this on high and low levels of winter feeding and on grazing?

b. The relation of rate and efficiency of gains the first winter under two levels of feeding to rate and efficiency of gain the following winter

c. The relation of rate and efficiency of gains of heifers to rate and efficiency of gains of their offspring when these heifers are feed tested under low and high levels of feeding

d. The relation of the weights at 18 months and 5.5 years of cows to their productivity as measured by weaning weights of their calves

5. The line of Angus at the Central station is being continued as a two-sire line with selection with equal emphasis on suckling gains, feed-test gains, feed efficiency, and score using an index and minimum culling practiced for low fertility and abnormalities. The young calves in this line appear thrifty and there will be a good calf crop this year. The three lines of Herefords at the Central station are being combined by a diallel mating scheme.

6. One bull in the Prince line sired seven out of nine calves that were abnormal (hydrocephalus). Because of the evidence that this condition might have been due to an interaction of genetics and nutrition where iodine appears to be involved in the phenotypic expression of inherited

hydrocephalus, 20 Prince cows and heifers were mated to this bull and half of them have been on iodized salt while the others have had no iodized salt. The 1961 calf crop resulted in no hydrocephalus in the group receiving iodized salt and one afflicted in the group not receiving iodized salt.

7. An analysis of the relationship between inbreeding and performance traits has shown a depressing effect of inbreeding of the calf on suckling gains, whereas both rate of gain and efficiency of gains have improved with increasing breeding. This is interpreted that the selection was not effective in overcoming inbreeding depression in the lowly heritable trait (suckling gains) while it was in the highly heritable traits (rate of gain and feed efficiency).

8. Average for males and females of the four lines at the Central Station have been calculated (table 1). It can be seen that males eat no more per unit of body weight than females but gain more rapidly and efficiently. The Angus have the highest suckling gains but the lowest rate and efficiency of gains on feed test. The David cattle are low in suckling gains but are high in rate of gains on test and the Prince are the most efficient of the lines.

Bulls from the four lines of Herefords have been bred to cows at the Union station and the steers have been fed out and carcass information obtained. The heifers from these matings are retained to measure cow productivity. Average values for production and carcass traits of steers sired by bulls of the four Hereford lines are shown in table 2.

It can be seen that the heaviest carcasses were from steers of David breeding. USDA grades and marbling scores were highest for the Lionheart steers. The steers from all the lines were satisfactory in performance traits but a greater degree of marbling would be desired in some of the lines. Our scores on cattle at Corvallis would indicate that the David line is least desirable in conformation. The carcass conformation score was also lower for steers sired by bulls of this line than those sired by bulls of the Prince and Lionheart lines. The Union cattle are compared at a disadvantage because bulls from this line do not sire calves showing the effects of heterosis as would be expected in steers from each of the other three lines.

The general information reveals that no one line is superior or inferior in all respects. It appears that we need to do some combining of lines to form the basis for establishing new lines. Thus, greater genetic segregation will occur enabling one to make progress through selection.

Table 1.--Performance data for lines of beef cattle on the breeding project

		Gain	Feed intake	Feed unit gain	Age at 500 lbs.	Age at 800 lbs.
Lionheart	Males	2.74	19.20	6.92	218	330
	Females	2.14	19.40	9.32	246	395
Prince	Males	2.77	17.98	6.31	224	332
	Females	2.17	18.18	8.71	252	397
David	Males	2.80	19.23	6.70	243	343
	Females	2.20	19.43	9.10	261	408
Angus	Males	2.35	19.15	8.38	215	340
	Females	1.75	19.35	10.78	243	405
Inbreeding 0		2.00	18.44	9.42		
1 - 10		2.33	18.81	8.29		
10 - 20		2.39	19.04	8.16		
over 20		2.43	19.25	7.86		

Table 2.--Performance and carcass traits of steers sired by bulls of the four lines of Herefords

Performance trait	Line of sire Lionheart 1	Prince 2	David 3	Union
Final weight	1016	1003	1037	982
Daily gain	2.27	2.18	2.28	2.12
Carcass weight	596	589	609	562
USDA grade	14.88	15.00	14.48	13.90
Dressing percent	58.56	58.71	58.64	57.19
Marbling score	12.50	11.33	10.28	9.19
Carcass conformation score	15.94	15.87	15.48	15.43
Percent fat	32.85	31.69	32.54	31.74
Number	25	15	18	21

VI. Worked Planned for Next Year

1. Continue the Angus line as a two-sire line with selection for suckling gains, feed test gains, feed efficiency, and score given equal emphasis in an index and with fertility and defects considered on a minimum culling basis.

2. Feed test all bulls and heifers born in 1962 as has been done in the past.

3. Combine the Lionheart, Prince, and David lines by a diallel mating plan. The general concept of this breeding project is that its function is to develop knowledge. It is not the thinking that an experiment station can have a large impact upon the genetic structure of the cattle population of the country through the development and release of breeding stock.

Combining the three lines in a diallel mating scheme would permit us to obtain information on specific and general combining ability, maternal effects, and linkage relations for production traits. In order to obtain the numbers needed for an analysis one would need a four-year study of combining the lines. The proposed scheme is outlined in table 3. This would give an approximate total of 108 bulls, the most of which could be used for carcass evaluation, and 108 heifers, 72 of which would be line-cross and 36 inbred.

Table 3. Mating scheme to be employed for the four-year study.

Line of cows	Line of bulls		
1	1 x 1	2 x 1	3 x 1
Number to breed	8	8	8
Number to test	3♂ 3♀	3♂ 3♀	3♂ 3♀
2	1 x 2	2 x 2	3 x 2
Number to breed	8	8	8
Number to test	3♂ 3♀	3♂ 3♀	3♂ 3♀
3	1 x 3	2 x 3	3 x 3
Number to breed	8	8	8
Number to test	3♂ 3♀	3♂ 3♀	3♂ 3♀

Totals for one year
72 cows bred, 54 calves tested
Totals for the four-year study
108 bulls, 108 heifers, 72 line cross and 36 inbreds of each sex.
All bulls not needed for breeding would be slaughtered to obtain carcass evaluations.

The plan would be to breed eight cows in each of the nine mating groups to assure six calves in each. Six calves in each would be individually fed. If more than six were raised to weaning, an attempt would be made to have equal males and females (3 percent of each) with the elimination

of the other calves prior to test. This would be done by random selection unless an abnormal calf exists which needs to be culled prior to making the selections.

All heifers feed tested would be retained in the Adair herd and bred to produce two calves as a means of (1) measuring the heterotic effects on female productivity, and (2) to provide a record for deciding which heifers would be selected for re-establishing lines. At least two lines of Herefords would be established from the females that had been calved in the Adair herd. If two lines are to be used these heifers would be divided into two groups randomly after the best 60 had been retained. One line would be headed by use of four of the best Lionheart bulls available and one by use of four good bulls from the U. S. Range Livestock Station, Miles City, Montana.

The crosses that would be made would allow a determination of specific and general combining abilities, maternal effects, and sex-linkage on growth rate, feed efficiency, fertility, and milking ability. All heifers produced each year and held in the Adair herd to produce two calves would be bred to the same unrelated inbred bull so that half the genotype of each would be constant; all would show heterotic effects and therefore should be able to respond to any amount of milk the dam would give, and reduced fertility would not be likely to result from inherited lethals.

The cows used to produce the line-cross offspring would be discarded as soon as the fourth calf crop is weaned in order to conserve space.

Some matings could be made to establish the new lines as soon as the first group of heifers have their second calf crop, because one would know by then the total number of heifers, from which the best 60 can be kept. One would also have a reasonable idea of what culling pressure could be placed on this group of heifers.

All animals would be kept intact for feed-testing. One or more males from each mating group each year would be slaughtered and carcass information would be obtained, including the best measurements available to our meats personnel at the time. Unless there was a strong demand for bulls, all would be slaughtered and carcass information obtained.

It would be best if two bulls out of each line could be used each year. The plan is to use two bulls each year and to use each bull for two years. Thus, if a total of four bulls are used over the four years from each of the three lines for making the crosses, it will be the plan to use bulls in this order for each line.

	Bulls for each line			
Year	A	B	C	D
1962	x	x		
1963		x	x	
1964			x	x
1965	x			x

Since several of the cows will be the same and the bulls will be used for two years, one will be able to adjust for the effects of years. This should make it possible also to get some estimate of variation due to sires within line. These values should enable one to more accurately measure the effects of general and specific combining ability, sex, maternal influences, and linkage.

The present plan is to use the same feed-test procedure in this study as has been practiced in the lines except to use grass hay and alfalfa hay and adjust the protein intake by changes in concentrate. But each of the four years the same ration will be fed. One then can determine the relationship between line performance and performance in the crosses. It would not injure the program to make a change in the ration from that presently used for the animals in this four-year program, providing no change is made during the four-year study.

Calves produced by the heifers in the crossing program would be raised to weaning and then made available for any study. Their value to the breeding program would terminate at weaning.

4. If assistance is available, it will be the plan to obtain information on the blood constituents that have been shown in our laboratory to be most closely related to performance. The plan at present would be to analyze for urea and amino acid nitrogen and for acid alkaline phosphotases at 500 and at 800 pounds body weights as a minimum. If more assistance is available, then we would analyze for these constituents at each 100 pound increment in weight from birth to 800 pounds body weight. In addition, urine levels of urea and allantoin would be determined at each 100 pound increment in weight.

5. Since the cooperative study at Squaw Butte is completed with the exception of analyzing data and preparing publications, it will be the plan to concentrate effort on publishing this material in order to complete and finalize this work.

6. The phase of the cooperative work at Union dealing with steers and bulls sired by bulls of the four lines of Herefords will have all the information gathered for the study when the last group of steers are slaughtered. It is the plan to concentrate effort on analyzing these data and preparing the material for publication.

7. The heifers at Union sired by bulls of the four lines are being bred to produce calves as a measure of cow productivity for further evaluation of the lines.

VII. Publications and Manuscripts

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PROJECT SUMMARY

Cattle Inventory

Purebred Oregon Agricultural Experiment Station

Breed	Hereford	Hereford	Hereford	Angus
Line	Lionheart	Prince	David	
Station	Central	Central	Central	Central
Bulls (12 mos. or over)	4	3	4	3
Cows (2 years or over)	21	18	18	20
Heifers, yearlings	4	6	6	2
Bull calves	3	5	5	4
Heifer calves	6	10	6	5
Percentage used for breeding project	66%	46%	72%	33%
Estimated cash value	23,270	17,290	17,730	18,000

Oregon Agricultural Experiment Station

Cow Production Data

Breed	Hereford				Hereford			
Line	Lionheart				Prince			
Cows bred to calve as 2-yr.-olds	0				0			
Calves born from 2-yr.-olds								
Alive	0				0			
Dead	0				0			
Cows bred to calve at 3 yrs. and up	17				17			
Calves born from 3-yr.-olds and up								
Alive	12				4			
Dead	1				5			
All Calves born								
Alive	13				4			
Dead	1				5			
Total	14				9			
Calves weaned	12				4			
Percent calf crop*								
Birth	92.8				44.4			
Weaning	85.7				44.9			
	Heifers		Bulls		Heifers		Bulls	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:								
Birth Weight	6	71	5	78	12	71	7	75
Weaning age	-		-		-		-	
Weaning weight	6	280	5	364	12	382	7	390
Adj. weaning wt. - 180 days	357		402		348		357	
Weaning score:								
Condition	6	10.1	5	11.8	11	10.3	7	10.4
Conformation	6	10.7	5	10.7	11	10.8	7	11.2

*(Birth) Percent calf crop = $\frac{\text{No. calves born alive}}{\text{Total no. of cows bred}}$

Weaning . . . . . = $\frac{\text{No. of calves weaned}}{\text{Total no. of cows bred}}$

Oregon Agricultural Experiment Station

Cow Production Data

Breed	Hereford				Angus			
Line	David							
Cows bred to calve as 2-yr-olds	0				0			
Calves born from 2-yr-olds								
Alive	0				0			
Dead	0				0			
Cows bred to calve at 3 yrs. and up	14				30			
Calves born from 3-yr.-olds and up								
Alive	10				22			
Dead	0				5			
All calves born								
Alive	13				25			
Dead	0				5			
Total	13				30			
Calves weaned	13				21			
Percent calf crop*								
Birth	92.8				83.3			
Weaning	92.8				70.0			
	Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:								
Birth weight	6	70	6	66	5	69	6	59
Weaning age								
Weaning weight	6	350	6	343	5	412	6	407
Adj. weaning wt. - 180 days	342		316		455		387	
Weaning score:								
Condition	6	10.4	6	10.1	6	8.3	5	10.6
Conformation	6	9.9	6	9.8	6	9.3	5	10.6

(Birth) Percent calf crop = $\frac{\text{No. calves born alive}}{\text{Total no. of cows bred}}$

Weaning . . . . . = $\frac{\text{No. of calves weaned}}{\text{Total no. of cows bred}}$

Feedlot Performance

Breed	Hereford		Hereford		Hereford		Angus	
Line	Lionheart		Prince		David			
Sex	♂	♀	♂	♀	♂	♀	♂	♀
Number on test	2	4	4	6	4	6	3	4
Average:								
Age on test	250	264	246	260	253	306	256	245
Initial weight	500	500	500	500	500	500	500	500
Initial score								
Condition	10.6	10.3	10.4	10.4	10.0	10.1	10.0	10.3
Conformation	12.1	10.9	11.1	10.7	10.3	9.8	11.4	11.0
Days on test	105	135	119	142	112	94	135	145
Gain								
Total	300	300	300	300	300	300	300	300
Average daily gain	2.80	2.14	2.49	2.12	2.84	2.25	2.27	2.08
Efficiency of feed utilization								
lbs. TDN/100 lbs. gain	627.7	847.1	624.1	742.2	621.3	862.0	757.2	872.2
or lbs. gain/100 lbs. TDN	-	-	-	-	-	-	-	-
Final weight	800	800	800	800	800	800	800	800
Final score								
Condition	11.8	12.4	11.7	12.8	11.6	11.6	12.5	11.6
Conformation	12.4	11.8	11.6	11.8	11.5	11.0	12.2	12.1

Oregon Agricultural Experiment Station

Young Animals on Feed

Purebred

	Hereford					
	Lionheart		Prince		David	
	Number Individually Fed	Number Group Fed	Number Individually Fed	Number Group Fed	Number Individually Fed	Number Group Fed
Bulls	0	-	1		1	-
Heifers	2	-	4		0	-
Steers	0	-	-	-	-	-

Land, Physical Facilities, and Equipment Used

Item	Number	Actual Cash Value	Percentage Used for breeding project
Land--Irrigated Pasture	64 acres	$400/acre	60
Dry Land Pasture	140 acres	$300/acre(av.)	60
Barns and lots		$730	60
Squeeze chutes	2 only	$750	60
Feed Carts	1 only	$100	100
Truck	1 only	$1,400	25
Loading chute	1 only	$500	25
Trailer	1 only	$450	20
Portable scales	1 only		50
Miscellaneous equipment and supplies		$350	25

UTAH STATE UNIVERSITY

I. Station: Utah Agricultural Experiment Station

II. Project Title: The development of breeding techniques and selection criteria for improvement of economically important characteristics in Hereford and Shorthorn cattle.

III. Personnel:
J. A. Bennett, D. J. Matthews, Arlin Knight, Junior Nyman, and Gren Owens.

IV. Nature and extent of work done this year.

This project was carried on according to the outlined plan with mild inbreeding and selection on the basis of performance being used. Two lines of Herefords and one line of Shorthorns were maintained. Some 16 dwarf carrier cows were maintained also. For inventory purposes they are counted with the Logan line of Herefords although from the line development and testing view they are not part of the line.

Hand feeding and self-feeding for bulls on test were compared again this year using the same all-pellet ration plus a small amount (one pound daily) of alfalfa hay. The self-fed bulls gained 0.48 pounds more per day than the hand-fed bulls. This shows a little greater advantage in favor of self-feeding as compared to the 0.33 advantage obtained last year. The self-fed groups averaged 2.88 daily gain this year which is very similar to the 2.83 pounds average daily gain obtained last year. The Shorthorn self-fed calves were outstanding in gain with the average gain of 3.32.

The data accumulated over the past years of the project were prepared for analysis and analysis is partially completed. One of the main purposes for making this analysis is to provide more exact adjustment factors. The level of inbreeding, in particular, has changed since the previous adjustment factors were calculated and the selection imposed may have altered other values. The analysis is being made on an within breed and within sex basis. Results of the Shorthorn heifer analysis showed that each increase of one percent in inbreeding of dam lowered weaning weight of calf 1.52 pounds and each one percent inbreeding increase in calf lowered weaning weight 0.58 pounds.

The second trial that was underway at the time of the W-1 meeting last year, under which the influence of some environmental factors upon tenderness of beef, was completed. Thirty-six animals were involved. The environmental factors considered were differences

in rate of gain prior to slaughter. One group, the fast gaining treatment, gained 2.82 pounds per day for the eleven-week pre-slaughter period. A second group, the fast-slow group, gained 2.99 pounds per day for the first seven weeks then were shifted to a ration where some actually lost weight while others gained approximately one-half pound a day. The third group averaged 1.25 pounds per day throughout the test. Results were in close agreement to the previous trial. Rate of gain prior to slaughter did not influence tenderness.

Correlation between marbling and tenderness was very low. The results of the two years trials have been prepared as a manuscript and submitted to the Journal of Animal Science.

V. Summary of progress:

Development of lines of Hereford and Shorthorn cattle through mild inbreeding accompanied by selection appears to be producing production lines of cattle. Level of inbreeding is still variable and rather low although many animals have coefficients in the range of 10 to 30 percent. Dwarfism has been held in check through a system of progeny testing young sires on known carrier cows prior to use in the herd. This has slowed progress in line development but it is felt that gene frequency of the dwarf gene has been lowered.

Trituim and N-acetyl-4 amino antipyrene have both been shown to be reasonably accurate as a means of estimating body composition in live cattle. Biochemical analyses of body fluids have also shown promise for helping to identify certain genotypes in cattle. Although these leads are promising they have not been fully perfected.

Studies of carcass quality indicates that in animals under 19 months of age tenderness is not influenced by rate of gain during the immediate pre-slaughter period.

Marbling which is stressed strongly in Government grading was found to have little or no relationship to tenderness in beef carcasses from young cattle.

VI. Application of findings:

This project is providing information on the value of mild inbreeding and selection as a tool for improving beef cattle. To date the results are highly encouraging. The project has also demonstrated to cattlemen of the state how performance testing may be advantageously carried out. Under the direction of the extension specialist, performance

testing has been conducted on the farm throughout the state. Approximately 1,000 animals are tested annually and a committee of cattlemen has been organized to regulate the testing program.

Progeny testing of young sires on known dwarf carrier cows has been shown to keep dwarfism under control although it involves extra expense in time and money.

VII. Work planned for the future:

1. Continue to develop lines of Hereford and Shorthorn cattle.

2. Start testing lines in crosses.

3. Study growth in cattle.

4. Apply biochemical tests for estimating genotypes in cattle.

5. Assist livestock specialist in keeping performance testing active in the producers herds in the state.

VIII. Publications and manuscripts:

Bennett, James A. 1961. Where are we on dwarfism. Washington State University. Stockmen's Handbook. p. 246.

Bennett, James A. 1961. Some aspects in supplemental feeding range cattle.. Washington State University. Stockmen's Handbook. p. 289. (This fits this project in part because genetic aspects as studied in the project were part of this report.)

Pre-slaughter rate of gain and tenderness relationship in cattle. Manuscript submitted to Journal of Animal Science.

Cattle Inventory PROJECT SUMMARY
Purebred Utah Agricultural Experiment Station

Breed	Hereford	Hereford	Shorthorn
Line	I	II	I
Station	Panguitch	Logan	Logan
Bulls (12 mos. or over)	11	4	7
Cows (2 yrs. or over)	45	27	34
Heifers, yearlings	14	3	8
Feeders, (yearlings)	22		6
Bull calves	21	12	19
Heifer calves	20	11	12
Percentage used for breeding project	90	90	90
Estimated cash value	25,000	15,000	18,000

Young Animals on Feed
Purebreds

	Hereford		Shorthorns	
	Number individually fed	Number group fed	Number individually fed	Number group fed
Bulls	16	0	6	0
Heifers	0	23	0	14
Steers	0	15	0	7

Utah Agricultural Experiment Station

Cow Production Data

Breed	Herefords				Shorthorns	
Line	Panguitch		Logan		Logan	
Cows bred to calve as 2-yr.-olds	7		1		9	
Calves born from 2-yr.-olds						
Alive	5		1		5	
Dead	5		0		1	
Cows bred to calve at 3-yrs. and up	46		27		30	
Calves born from 3-yr.-olds and up						
Alive	41		26		29	
Dead	2		1		0	
All calves born						
Alive	46		27		34	
Dead	7		1		1	
Total	53		28		35	
Calves weaned	41		26		35	
Percent calf crop weaning	77		92		90	
	Bulls No. Av.	Heifers No. Av.	Bulls No. Av.	Heifers No. Av.	Bulls No. Av.	Heifers No. Av.
Average:						
Birth weight	24 68	17 69	18 75	9 70	19 70	16 66
Weaning age	210	209	189	193	218	209
Weaning weight	395	415	415	394	448	400
Adj. weaning wt.-190 days	428	411	433	428	444	430
Weaning score:						
Condition	2.47	2.19	2.25	2.49	2.28	2.29
Conformation	1.93	1.83	1.89	2.13	1.84	1.84

Utah Agricultural Experiment Station

Feedlot Performance

Breed	Hereford	Hereford	Shorthorn
Line	Panguitch	Logan	Logan
Sex	Bull	Bull	Bull
Number on test	13	3	6
Initial weight	486	517	571
Initial score:			
Condition	2.19	2.10	2.08
Conformation	1.83	1.90	1.73
Efficiency on feed utilization			
lbs. gain/100 lbs. TDN	22.7	22.5	20.9
Final weight	796	835	887

Land, Physical Facilities and Equipment Used

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Land - Panguitch	155 acres	31,000.00	90
Land - Logan	330 acres	80,000.00	80
Shed, yards	5 units	60,000.00	90
Metabolism Building	1	60,000.00	5
Laboratory equipment - Chemical		1,500.00	100

WASHINGTON STATE UNIVERSITY

I. Station: Washington Agricultural Experiment Station, Pullman, Washington.

II. Project Title: Improvement of beef cattle by selection and mild inbreeding within lines of the Hereford, Angus, and Shorthorn breeds.

III. Personnel:

Experiment Station:

C. C. O'Mary, Gary Smith, M. E. Ensminger, and W. T. Bennett

U. S. Department of Agriculture

R. T. Clark, Coordinator, and J. S. Brinks

IV. and V. Nature and Extent of Work Done This Year and Summary of Progress and Conclusions to Date.

The project has been in the process of being revised for some time. The physical setup has improved considerably during the past year and should allow for improvement in the design of the revised program. The acquisition of additional land will make it possible to carry on the research without rented pastures. The expansion of the Angus herd will allow the research to be conducted in this line of cattle with larger numbers and with much more control than in the past.

Results of the feed efficiency study on the 1960 calf crop follow: Forty-seven purebred heifers and bulls fed an all pelleted ration were used to study rate and efficiency of gain and their correlations during a 150 day time-constant test, and within 100 pound live weight increments. For both heifers and bulls, feed efficiency decreased as live weight increased. The feed requirements for bulls, per 100 pounds of gain for the 500-600, 600-700, and 700-800 pound bull groups were 580, 723, and 755 pounds and for heifers in the 400-500, 500-600, 600-700, 700-800, and 800-900 pound groups were 672, 774, 806, 907, and 915 pounds respectively. The average daily gains for heifers from 400 through 900 pounds by 100 pound increments were 1.71, 1.72, 1.81, 1.66, and 2.05 respectively. Average daily gains for bulls by 100 pound increments beginning at 400 pounds were 2.21, 2.33, 2.22, 2.38, 2.36, 2.15, and 3.74. Correlation coefficient between rate of gain and feed efficiency for bulls for the total period was -.90 with 5 degrees of freedom while correlations within increments of 500-600, 600-700, and 700-800 pounds were -.81, -.96 and -.89 with 5, 5, and 3 degrees of freedom. In heifers, the correlation coefficient for

the time-constant test was -.41 with 19 degrees of freedom while correlations within increments of 400-500, 500-600, and 600-700 pounds were -.88, -.90 and -.88 with 10, 14, and 8 degrees of freedom, respectively. Thus in heifers, rate of gain and feed efficiency were more highly correlated within all weight groups than in the time-constant test.

In the management of the feedlot performance for 1961, a changeover was made from bedding with straw to bedding with shavings where animals were on an all pelleted ration. It had been observed that the animals would consume some of their straw bedding. This year some fresh shavings were consumed. However, bloat became much more of a serious problem and it became necessary to add additional straw to aleviate continuous bloat on some animals. Other animals had to be removed.

Some funds were made available for putting performance records on IBM cards. The information is now being assembled on the performance of the individual animals beginning with 1947. Many of the records are incomplete, but some information is available since the beginning of the W-1 project. Additional work and checking of records will be necessary before this is completed for IBM work. Records are being continued on animals through a time constant test of 150 days in comparison with an age constant test of 150 days beginning at 243 days and concluding when the animals reach 393 days.

The first steers are now being slaughtered from this project. This information is not yet summarized.

VI. Application of Findings:

The data will be summarized after it has been assembled and findings made known at that time.

VII. Work Plan for the Future:

The main problem for this next year is to continue the development of the land area, fencing and pastures, so that the breeding project will be underway as of the breeding season, 1963. Further, individual feeding tests will be continued and records will be kept on both a time constant and an age constant basis. The bottom half of the male progeny will be fed to 1000 pounds and slaughtered for carcass information. Work on the records to get them on IBM cards for summary will be continued.

VIII. Publications and Manuscripts:

Smith, Gary, C. C. O'Mary and M. E. Ensminger. 1961. Rate of gain and feed efficiency within specific weight increments in growing beef cattle. Journal of Animal Science, 20:911 (Abstract).

Smith, Gary C., 1962. M. S. Thesis in Animal Science. Effects of management systems on rate and efficiency of gains in the performance testing of beef calves.

Cattle Inventory PROJECT SUMMARY
Purebred Washington Agricultural Experiment Station

Breed	Angus	Hereford	Shorthorn
Line	Angus	Hereford	Shorthorn
Station	Pullman	Pullman	Pullman
Bulls (12 mos. or over)	12	7	9
Cows (2 yrs. or over)	46	36	28
Heifers, yearlings	10	7	4
Bull calves	19	13	12
Heifer calves	14	8	6
Percentage used for breeding project	100[1]	100[1]	100[1]
Estimated cash value	$39,310	28,025	21,400
Grade	None	None	None

[1] Owned and used in the teaching budget.

Washington Agricultural Experiment Station

Cow Production Data — 1961 Calf Crop

Breed	Shorthorn			Angus			Hereford		
Line	1			Eileenmere			1		
Cows bred to calve as 2-yr.-olds	1			0			0		
Calves born from 2-yr.-olds									
Alive	0			0			0		
Dead	0			0			0		
Cows bred to calve at 3 yrs and up	19			24			23		
Calves born from 3-yr.-olds and up									
Alive	18			24			19		
Dead	0			0			0		
All calves born									
Alive	18			24			19		
Dead	0			0			0		
Total	18			24			19		
Calves weaned	18			23			19		
Percent calf crop*									
Birth	90			100			82.6		
Weaning	90			95.8			82.6		

	Bulls		Steers		Heifers		Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:																		
Birth weight	12	76	2	66	4	64	7	66	4	65	9	61	6	69	2	60		65
Weaning age		207		237		224		204		212		191		173		211		202
Weaning weight	12	525	2	578	4	473	7	490		513		434		437		445		416
Adj. weaning wt. - 180 days		462		454		393		430		446		394		452		380		374
Weaning score:																		
Condition	---		---		---		---		---		---		---		---		---	
Conformation	---		---		---		---		---		---		---		---		---	

* $\frac{\text{Calves born or weaned}}{\text{cows bred}}$

Washington Agricultural Experiment Station

Feedlot Performance

Breed	Angus	Angus	Angus	Hereford
Line	Eileen-mere	Eileen-mere	Eileen-mere	1
Sex	Bulls	Steers	Heifers	Bulls
Number on test*	7	3	5	2
Average:				
Age on test	238	255	205	217
Initial weight (average)	534	549	515	499
Days on test	150	150	150	150
Gain				
Total	2198	818	992	734
Average daily gain	2.09	1.82	1.32	2.45
Efficiency of feed utilization lbs.feed/100 lbs.gain	733	810	1015	656
Final weight (average)	848	822	713	866
Final Score Conformation**	13.3	13.0	13.8	13.5

(Continued) Breed	Hereford	Hereford	Shorthorn	Shorthorn	Shorthorn
Line	1	1	1	1	1
Sex	Steers	Heifers	Bulls	Steers	Heifers
Number on test*	2	5	8	2	4
Average:					
Age on test	252	228	237	267	255
Initial weight (average)	469	486	576	569	552
Days on test	150	150	150	150	150
Gain					
Total	598	943	2877	597	886
Average daily gain	1.99	1.26	2.40	1.99	1.48
Efficiency of feed utilization lbs.feed/100 lbs.gain	702	940	715	860	922
Final weight (average)	768	674	936	868	774
Final Score Conformation**	---	13.8	13.9	14.0	14.0

* Other animals were on test but did not complete the test for various reasons.

** Note 1 = 16 2+= 14 2-= 12
1-= 15 2 = 13 3+= 11

Washington Agricultural Experiment Station

Young Animals on Feed

Purebred

Breed	Angus	Hereford	Shorthorn
	Number individually fed	Number individually fed	Number individually fed
Bulls	7	2	8
Heifers	5	5	4
Steers	3	2	2

Land, Physical Facilities, and Equipment Used

Item	Percentage Used for Breeding Project
Two hundred and forty acres of additional land has been acquired for pasture in 1963.	100

UNIVERSITY OF WYOMING

I. Station: Wyoming Agricultural Experiment Station, Laramie, Wyoming, and Gillette Substation, Gillette, Wyoming

II. Project Title: W. S. 655 Criteria for improving effectiveness of selection in beef cattle

III. Personnel:

Experiment Station:
G. E. Nelms, C. O. Schoonover, P. O. Stratton, and graduate students and farm laborers

U. S. Department of Agriculture, Agricultural Research Service
R. T. Clark, Coordinator
J. S. Brinks

IV. and V. Nature and Extent of Work Done This Year and Summary of Progress and Conclusions to Date:

After 3 years of attempting to freeze semen from bulls 12 to 14 months of age, it is felt that resulting fertility is too erratic to be of much value. Apparently, the methods used in evaluating semen from mature bulls is not adequate for the evaluation of young bull semen. Conceptions resulting from frozen semen from young bulls has been unpredictable. It was found, also, that semen quality was affecting any selection for carcass quality, in that all bulls, apparently, were not of the same degree of sexual maturity at this young age. It would be impossible to obtain semen from some bulls in time for use in the year that the bulls would be yearlings.

The Angus bull calves were slaughtered at monthly intervals beginning at three months of age. The resulting carcasses were dissected and the growth of various muscles are being studied. Three bulls were studied at each interval. The means for the measurements are presented in table 1. The simple correlation of the muscle measurements and weight and age are shown in table 2. These data are being accumulated in order to establish a growth pattern for muscle growth. It is felt that this information is necessary in order for more accurate selection for carcass traits. The analyses are incomplete, in that only data to weaning age are included. The slaughter of Angus bulls will be continued beginning at weaning. Enough bulls are available now to extend the information to approximately 15 months of age.

Table 1. The means for the various muscle measurements at 30-day age intervals

Item	Age Groups				
	90-120	120-150	150-180	180-210	210-240
Carcass wt.	94	153	190	218	234
Longissimus dorsi					
Length (cm)	53.8	60.2	61.6	63.0	67.7
Weight (lb)	2.22	3.46	4.61	4.73	5.10
Area Ribeye ($in.^2$)	5.71	5.57	7.09	7.77	7.28
Semitendinosus					
Length (cm)	26.0	28.5	29.5	32.7	32.9
Weight (lb)	0.92	1.48	1.96	2.09	2.26
Supraspinatus wt.	0.48	0.62	0.81	0.92	1.02
Infraspinatus wt.	0.59	0.98	1.37	1.30	1.37
Forearm group	1.09	1.42	1.69	1.79	2.04
Total wt. of muscles	5.31	7.96	10.44	10.84	11.81

Table 2. Simple correlation coefficients between muscle measurements and age and weight

	Age	Carcass Weight
Longissimus dorsi		
Length	.81	.72
Weight	.91	.76
Area Ribeye	.80	.85
Semitendinosus		
Length	.79	.68
Weight	.84	.76
Supraspinatus weight	.94	.77
Infraspinatus weight	.85	.72
Forearm group weight	.91	.77
Total Weight of muscles	.87	.76

Table 3. Mean and Standard Deviation of Carcass Measurements Data from 15 Hereford bulls from Gillette Station

Item	Mean	Standard Deviation
Carcass weight (lbs.)	401.5	52.0
Age of slaughter (days)	370.7	12.8
Carcass wt./age	1.08	.12
Longissimus dorsi		
Length (cm)	76.8	3.25
Weight (lb)	8.69	.96
Area Ribeye ($in.^2$)	11.28	1.41
Length of carcass (cm)	106.9	4.73
Semitendinosus		
Length (cm)	33.2	1.76
Weight (lb)	3.55	.48
Supraspinatus wt. (lb)	1.75	.23
Infraspinatus wt. (lb)	2.51	.39
Forearm group wt. (lb)	3.23	.39
Total wt. of muscle groups (lb)	19.7	2.29
Weight of bone (lb)	30.4	2.97

Table 4. Simple Correlation Coefficients Among Some Muscle Measurements and Carcass Weight and Age. Data taken from 15 Hereford bulls from Gillette Station

Item	Carcass Weight	Age	Carcass Wt./Age
Longissimus dorsi			
Length (cm)	.69	.29	.71
Weight (lb)	.95	.61	.94
Area of Ribeye ($in.^2$)	.73	.75	.63
Length of carcass (cm)	.94	.57	.92
Semitendinosus			
Length (cm)	.81	.45	.81
Weight (lb)	.91	.70	.94
Supraspinatus wt. (lb)	.93	.54	.93
Infraspinatus wt. (lb)	.92	.62	.88
Forearm group wt. (lb)	.87	.27	.93
Total weight of muscle groups (lb)	.98	.61	.96
Weight of bone (lb)	.84	.54	.82

So that similar growth patterns can be established for other breeds, similar data are being accumulated on all bulls that are slaughtered. An example of these data are presented in tables 3 and 4. All possible correlations are being determined.

In attempts to synchronize estrus, Provera (The Upjohn Co.) when fed, has been successful to some extent. When fed at 210 mg./day/head for 15 days, approximately 75% exhibit estrus within a 3-day period. Based on 275 head that have been treated during 1961-62, it appears that fertility approaches that found in normally cycling cows. Most cows that do not exhibit estrus during the initial 3-day period, return one heat period later. It has been shown at Cornell that some cows ovulate without exhibiting heat, and will conceive if inseminated. This is being investigated this year.

Application of Findings:

There is considerable interest among commercial cattlemen to produce meatier type slaughter animals. However, detailed information regarding muscle development is not available. For the most accurate selections this information would be desirable. The studies reported here will provide some of this information.

It is felt by ranchers practicing A.I. that the synchronization of estrus and ovulation will enhance this practice. The studies reported here indicate that this can be achieved.

VI. Work Planned for the Future:

Work will be continued on muscle development. Data involving a group of body measurements taken at birth will be analyzed during the year. Instead of collecting semen and slaughtering bulls at 12-14 months of age, they will be held until 16-18 months of age. A bank of semen will be stored and then bulls slaughtered for carcass evaluation. The project will be continued as outlined.

VII. Publications:

Nelms, G. E.
New breeding techniques in beef cattle. Presented to Wyoming Stockgrowers, Sept. 1961.

Nelms, G. E.
Selection for and maintaining fertility in beef cattle. Uinta County Beef School, Feb. 1962.

Nelms, G. E. and Weslie Combs. 1961. Estrus and fertility in beef cattle subsequent to the oral administration of 6-methyl-17-acetoxyprogesterone. J. An. Sci. 20:975.

Cattle Inventory PROJECT SUMMARY

Purebred Wyoming Agricultural Experiment Station

Breed	Hereford	Angus	Shorthorn	Hereford	Crossbred
Line	Laramie			Gillette	
Station	Wyoming	Wyoming	Wyoming	Wyoming	Wyoming
Bulls (12 mos. or over)	8	1	6	5	
Cows (2 yrs. or over)	48	42	36	31	
Heifers, yearlings	11	7	6	8	
Steers, yearlings					30
Bull calves	16	27	16	16	
Heifer calves	15	9	3	15	
Percentage used for breeding project	100	100	100	100	100
Estimated cash value	16,100	14,250	11,200	13,600	4,500

Wyoming Agricultural Experiment Station

Cow Production Data

Breed	Shorthorn	Hereford
Line	Laramie	Gillette
Cows bred to calve as 2-yr.-olds	6	8
Calves born from 2-yr.-olds		
Alive	5	7
Dead	1	0
Cows bred to calve at 3-yrs. and up	28	29
Calves born from 3-yr.-olds and up		
Alive	2	25
Dead	2	0
All calves born		
Alive	31	32
Dead	3	0
Total	34	32
Calves weaned	28	32
Percent calf crop*		
Birth	91*	87*
Weaning	82**	87**

	Bulls		Steers[1]		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:										
Birth weight	8	73	17	74	8	63	18	77	14	70
Weaning age		190		166		194		182		179
Weaning weight	7	355	15	378	6	332	18	397	14	318
Adj. weaning wt. - 180 days		340		403		314		393		322
Weaning Score not taken										

*No. born alive/cows in breeding pasture

**No. weaned/cows in breeding pasture

[1]Crossbred steers and heifers

Wyoming Agricultural Experiment Station

Cow Production Data

Breed	Hereford			Angus		
Line	Laramie			Laramie		
Cows bred to calve as 2-yr.-olds	9			8		
Calves born from 2-yr.-olds						
Alive	6			5		
Dead	0			0		
Cows bred to calve at 3 yrs. and up	41			32		
Calves born from 3-yr.-olds and up						
Alive	37			29		
Dead	1			1		
All calves born						
Alive	43			34		
Dead	1			1		
Total	44			35		
Calves weaned	42			32[2]		
Percent calf crop*						
Birth	88*			85*		
Weaning	84**			80**		

	Bulls		Steers[1]		Heifers		Bulls[2]		Steers[1]		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	17	72	14	70	12	69	19	53	6	61	9	51
Weaning age		174		149		180		---		159		197
Weaning weight	17	342	13	294	12	315			6	333	7	350
Adj. weaning wt. - 180 days		350		339		315		---		368		325
Weaning score not taken												

* No. born alive/No. cows in breeding pasture

** No. weaned/No. cows in breeding pasture

[1] Crossbred steers and heifers

[2] Bulls slaughtered prior to weaning

Wyoming Agricultural Experiment Station

Feedlot Performance

Breed	Hereford		Shorthorn		Angus		Hereford	
Line	Laramie		Laramie		Laramie		Gillette	
Sex	♂	♀	♂	♀	♂	♀	♂	♀
Number on test	13	11	7	6	0[2]	7	18	14
Average:								
Age on test						204	192	189
Initial weight	341	310	359	330	---	358	403	322
Initial score								
Condition	---	---	---	---	---	---	---	---
Conformation	---	---	---	---	---	---	---	---
Days on test	168	168	168	168	168	168	168	168
Gain								
Total	355	295	364	266	---	258	377	245
Average daily gain	2.12	1.76	2.17	1.59	---	1.54	2.25	1.52
Efficiency of feed utilization								
lbs.TDN/100 lbs. gain	361	---	369	---	---	---	---	---
Final weight	696	605	723	596	---	616	780	567
Final score								
Condition	---	---	---	---	---	---	---	---
Conformation	---	---	---	---	---	---	---	---

[2]Angus bulls slaughtered prior to weaning

Wyoming Agricultural Experiment Station

Young Animals on Feed

Purebred

	Hereford		Shorthorn		Angus	
	Number individually fed	Number group fed	Number individually fed	Number group fed	Number individually fed	Number group fed
Bulls	13	0	7	0	0	0
Heifers	11	0	6	0	0	7
Steers	0	0	0	0	0	0

Grade (Crossbred)

Bulls	0	0	0	0	0	0
Heifers	0	5	0	8	0	2
Steers	0	9	0	9	0	4

Land, Physical Facilities, and Equipment Used

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
600 acres of range and irrigated land (Replacement for lands lost to Interstate Highway)		2750.00/Yr.	100%
Farm Truck (partial)	1	1600.00	40%
Fat extractor	1	215.00	80%
Electric drying oven	1	195.00	50%
Bull probe	1	42.00	100%
Adding machine	1	50.00	50%
Meat lab. equipment (tables, grinder, fat fryer)		800.00	60%
IBM dictating executary	1	450.00	20%
Rotary tattoo	1	25.00	100%
Cattle chute	1	275.00	20%
Thermo oven	1	45.00	30%
Clipmaster	1	50.00	20%
Wagon hitch & bale chute	1	22.00	35%

Arizona--Dr. O. F. Pahnish

We are still analyzing data from the Empire and Arivaca Ranches. Most of our effort is being concentrated on the Apache work. We are continuing the collection of data as outlined in the original plan, including top cross tests on Miles City bulls from Lines 1, 6, 9, and 10.

We are still collecting blood samples. We have large blocks of data on several blood constituents and these are being analyzed statistically through the Denver office.

In the report last year the results of analyses on weaning and fall yearling data were presented. Detailed analyses are given in the current report for the intermediate period data collected at the end of the first winter following weaning time.

Line 9 animals are extremely easy to handle--better than Line 1. Line 6 is at the other end of the scale.

Progeny tests on first-calf heifers were run. Mothering ability of top cross females was studied. What we see in mothering ability is different from what we see in the growth of the top crosses themselves, as we had observed originally.

California--Dr. P. W. Gregory

A series of slides was shown illustrating the work on various types of dwarfs, emphasizing the anatomical phases of the station's research.

Hawaii--Dr. Estel Cobb

We have made considerable progress in our beef cattle work even though we don't have a great deal of data analyzed to show this progress. We have set up a beef cattle station on the island of Hawaii which we hope to have in an operating state next year. We have no money for cattle in this year's appropriation. We hope to do ranch nutrition work and some breeding work if we can get the appropriation for cattle and possibly for an additional animal breeder for stationing on that island. We are very much interested in this

problem of genetic-environmental interaction. We feel it is important to us for our environment is quite different and many of the bulls come from the mainland. Some have a bad time getting acclimated, particularly as to feed. They need a good feeding regimen or they don't hold up. Since we will be looking for cattle to put at that station, if any of you have lines or strains of cattle that might be of benefit to us we might be able to get some to use in Hawaii and contribute to genetic-environmental interaction knowledge.

We have continued to gather data at cooperating ranches. We are in the process of analyzing weaning data including this year's weaning data. We hope to get all of the information we can out of this on weaning score and weight and gain birth to weaning prior to next year. We are working also on analysis of postweaning gains.

On one cooperating ranch we continue to select cattle within the herd on basis of performance, rate of gain, and conformation score. There are tremendous variations in environment from year to year so it is hard to tell whether we make any gains, but young sires outproduce older sires so we feel we are making gains in the herd. Older sires have gone out because of production as well as because of age. They have not held up with the younger sires.

Most of the time has been spent collecting data on progeny testing at the station. We select six steers from each sire if possible--not the best nor the worst. Our steers are slaughtered at a constant weight--put on test at 600 pounds, slaughtered at 1,000 pounds. A preliminary analysis of the first year's part of the study is included in the report. The low association of area of rib eye with anything else that seems to be of importance is evident. It disturbs me greatly that all of the performance testing projects being set up on the meat rail put so much emphasis on area of rib eye (except that it is easy to take). We have not been able to demonstrate its importance with our data.

Other than area of rib eye, I would like to mention specific gravity. Correlation between percent waste and specific gravity is a high negative; correlation between rib eye area and specific gravity is a small negative value; between carcass grade and specific gravity is moderate. We feel that specific gravity is not too bad a measurement.

Industry is beginning to waken up very rapidly to what we are doing and everyone is wanting to jump on the bandwagon. We are making available adjustment factors from information obtained in ROP work.

All original ranches either are back in ROP on their own or are having us help them set up programs as of this year because other ranches are getting into testing on their own places. We are trying to get ranches which have better cattle to get into a program to produce their own bulls, for they will have better cattle than can be imported from the mainland.

Results of the research project are being used in the field in Hawaii, and there is a great interest in this program. We held two schools on Hawaii on ROP and had all the cattle represented by means of rancher representatives.

Idaho--Dr. R. E. Christian

Semen production in the young beef bull--I hesitate to call it age of puberty and would rather call it age at which we can first successfully collect an ejaculate.

The age at which we first obtained a satisfactory ejaculate was

Hereford	341.2 days
Angus	401.7
Shorthorn	340.3

In the Hereford the first semen sample is satisfactory, but with the Angus there is a lag between the first ejaculate and the first satisfactory semen sample.

As to actual length of storage life of semen, either raw or diluted, at 40° F., semen from Angus will not store. A day after collection we no longer have motility in the semen, whereas Hereford and Shorthorn will store, Hereford for 2 1/2 days, Shorthorn the same, Angus somewhat less than a day.

We have noticed that the Angus are much more sensitive to the ejaculator than are Hereford and Shorthorn. The Hereford and Shorthorn require approximately the same amount of electric current to produce effect, Angus considerably less.

We are considering electroejaculation and the artificial vagina next year for collecting semen. We are using a regular probe. After they once start producing semen samples we collect from each bull every Saturday morning. It takes an hour to an hour and a quarter to finish. It appears that there is considerable variation from time to time in semen quality.

Dr. Kieffer: Should semen collection start earlier than eight months?

Dr. Christian: We start at eight months when the bulls go into individual pens. The artificial vagina may present some problem in training the young bulls to use it. We may be able to start collecting semen at 210 days, but no earlier than that.

Puberty is the age at which an animal is first capable of reproduction. But for our set-up we say when we produce satisfactory samples. Sexual maturity is the age at which an animal reaches maximum reproductive capacity.

Dr. Warwick: Will you set up an electronic technique adapted to these young bulls?

Dr. Christian: I don't know. All I can say is we are collecting with the regular bull ejaculator.

ROP has become quite a program in Idaho. We have somewhere near 150 to 175 herds in ROP, and ranchers have become very much interested in it and also in pregnancy testing in cow herds.

Montana--Professor F. S. Willson

We didn't do too much in the line of publications this year. However, we proceeded about the same as usual with indexing cattle at Montana. Progress so far--completion of testing of these selection procedures that have been going on for about five years with visually selected bulls and those selected under ROP.

We discussed the cooperative work with the Montana Hereford and the Montana Angus associations. The last crop of calves is now on feed at Miles City, checking out these two programs. We have compared four crops of calves from these lines and Miles City tested cows and two out of the four years bulls selected at Bozeman from ROP lines have been up with Line 1. This year our ROP line was out ahead of Line 1. The visual appraisal group consistently has been at the bottom of the group. On carcass quality there has been practically no difference. It has been pretty much the same. It appears we have been able to step up the gaining ability without losing anything on carcasses. This is encouraging because with the last two crops the sires selected by the associations were every bit as large as our ROP sires, whereas previously the bulls were two to three hundred pounds smaller at two to three years of age.

The thing we are most interested in is the work at the Havre station.

North Montana Branch Station, Havre--Mr. Claude Windecker

Crosslines until the past two years were exceeding the controls. During the past two years the controls have been equal to the crossline progeny. When we compare rancher cattle with station cattle, last year when we had rancher cattle from seven different ranches we were getting maximum differences of from 19 to 20 percent and average differences of 15 percent. Then we started putting out high-gaining bulls with different ranchers. We are still getting differences in crossline matings with larger cattle. We are getting a 10 percent increase. We bring in six rancher x rancher and six rancher x station bull calves.

Dr. Warwick: This project at Havre has been going on quite a little while and the cattle are doing quite well. Do you attribute that to combining ability per se, or would you have done as well with one population and selection pressure?

Mr. Flower (Montana): We are checking on the trend in heterosis. Most of the selection pressure seems to have been for mass selection. Our project won't be a very good answer to this question. We will have to progeny test a larger number of sires.

Professor Willson (continuing Montana report)

Application of findings--performance tested cattle in comparison with other Montana cattle did remarkably well, marketing 70 pounds more gain per head.

At Bozeman, where we have brought in certified calves and put them in our feedlot with uncertified calves, we found 69 pounds weight advantage in gaining ability during the feedlot period. This is encouraging, and running about the same right along. It is creating quite a bit of demand that we cannot satisfy at the moment where certified calves are concerned.

Dr. Bennett: What percentage of sires produce certified calves?

Professor Willson: They are the top half of the bulls.

Dr. Clark: Monday (July 9) we had a vistor in Denver looking for 50,000 steer calves by certified bulls for fall delivery. Can such an order be filled?

Professor Willson: We can't fill the orders now for certified calves. As these feeders put the pressure on commercial men to furnish this kind of calves the commercial men put the pressure on the registered breeders for indexed bulls. This has brought about quite a different viewpoint on the part of our purebred breeders.

U. S. Range Livestock Experiment Station--Dr. N. M. Kieffer

On our project on the development of methods of measurement of beef cattle, we are working with steer progeny on record of performance tests. Of our slaughter groups of steers the first group of steers to reach slaughter weight consisted of three Charolais x Hereford and three straight Hereford. The second group was 4 Charolais x Hereford and two Hereford. The third group had four of the crossbreds, the fourth group two crossbreds. The fifth and sixth group were all Herefords. There were 13 of the Charolais x Hereford crossbred steers in all.

There is quite a striking difference in the conformation of calves from these different line crosses. Representative samples will be selected for certain work this fall. Animals will be tested out in the feedlot and subsequently carcass data will be obtained. The project will be continued two more years.

In the crossbreeding work we are using four breeds of cows and three breeds of bulls. The first of the calves are on the ground and all look pretty good. The heaviest birth weights are the Charolais x Brown Swiss, which average 100 pounds at birth.

The genotype-environmental interaction program we initiated last fall by shipping 63 Line 1 females and two Line 1 bulls to Brooksville which were bred to correspond to their breeding season at Brooksville and started calving in January. This fall we will ship some Line 1 weanling heifer calves to Brooksville and they will ship 50 head of females and two bulls to Miles City this fall.

In the carcass group of cows, 30 head of grade Herefords were selected on the basis of certain carcass traits in their steer progeny. Last year we selected 30 additional cows which are being bred as a group. These are selected for three traits--rib eye, fat thickness, and tenderness--equal emphasis being given each trait.

We tested four of the first bull progeny from the first group of 30 cows in the feedlot last year and selected one bull to go back

into the herd. The four bulls we kept were selected on basis of their dam's index.

Our steers were slaughtered this week (July 9) in St. Paul--46 head made up of 8 Brown Swiss and 38 Herefords. These were photographed by three-dimensional photography three weeks before shipping and we obtained the weights of the different cuts on these cattle and want to check these out. We got the rough cuts. We will get the proportions but not the meatiness.

Nevada--Dr. C. M. Bailey

We analyzed some data from the rat project and have obtained some clues. We analyzed data from generations 7 and 8, selected for 70-day body weight under two planes of nutrition: one, concentrate mixture throughout lifetime and, two, concentrate mixture except during feed test, 40 to 70 days. We analyzed data from two generations, two sexes. We tried all sorts of things with these data--we had disproportions, interactions.

We calculated the means for different generations and sex groups. In the table in the report the first two columns are means for rats fed concentrate mixture during the test, the second two columns, rats fed roughage mixture during the test. SS rats are from lines selected throughout lifetime fed concentrate mixture. RS rats are from lines selected at the end of performance and fed roughage during the performance tests.

During 1960-61 tests using a diet recommended by the nutritionists trying to get some idea of digestibility of feeds, we did not expect any line differences. The main value is digestibility values for the feeds we were feeding. We got very similar figures to previous tests. We came up with a figure on digestibility of the feed mixture we were using the same as the digestibility figures in use. We checked these values for line differences. There was no line difference, but there was a highly significant sex difference at Reno but not at Knoll Creek.

At Reno, starting the test in 1961, we took blood samples which were analyzed.

The carcass work will be continued. We had 9-10-11 rib cuts from 1959-60 and 1960-61 tests.

A project revision is due in 1963, so it will reflect more accurately what we are doing.

New Mexico--Dr. L. A. Holland

We finished the analysis of the vaginal prolapse data. Work is being done on the live animal and carcass data.

We found a heart defect in our cattle, a hole in the ventricular wall. It is reported in human beings but not in cattle. So our "Old Line" might not be as good as we thought it to be. We are trying to get outside money to study this heart condition, so we want to hang onto this Old Line. It was picked up when Dr. Belling instituted autopsying everything that died on the place. Previously this was not done, so we don't know when the defect might have originated. Calves have been when we found them, calves born dead, or which have died by the time we find them.

Oregon--Dr. Bogart

We had hydrocephalus occur with six out of eight calves by one bull so we mated this bull to cows that previously had produced hydrocephalus calves, but put half of them on iodized salt. We had one calf with hydrocephalus from the group not receiving iodized salt. So our selection for it has been as effective as New Mexico's against it.

We are doing a study in cooperation with the Union station, having sent bulls from our three lines of Herefords, where they are bred to a group of commercial cows. We are feeding out the steers and getting carcass information. The line at Union has not been selected the same as our other lines. There is some slight relationship between the bulls and the commercial cows, so we would be comparing at some disadvantage. But the three lines there differed a great deal but no one line was superior in all respects. All lines have good genetic material but no line has everything we want. So we will consider combining.

Our studies on inbreeding showed that on rate of gain as inbreeding went up rate of gain went up. I don't think inbreeding caused them to gain more rapidly, but selection has been effective.

Feed per unit of gain went down as inbreeding went up. We selected and were making progress as inbreeding was going up.

We found that on a per unit of body weight basis heifers ate as much as or more than bulls, but a bull will outgain heifers, so obviously bulls are very much more efficient.

Utah--Dr. J. A. Bennett

We have continued the bull feeding test. We weigh the bulls every Saturday morning before we hand feed them. We have been concerned as to whether we are getting some damage in the rumen wall. We cull about a fourth of the bulls immediately when we finish the test. We think there is a little thickening on the rumen wall but we think on an all-pelleted ration there is thickening if you feed for 50 or 60 days. The bulls seem to adjust to long feed rather easily after the test.

At the time of our last meeting we were slaughtering some animals on test for carcass studies. Our interest was in environmental influence on tenderness. We ran two tests. Thirty-six animals, all wintered together on alfalfa hay and corn silage, were used. We put one third on full feed. They gained 2.82 pounds per day for eleven weeks. One third were on the same high level until four weeks before slaughter, then were changed to alfalfa hay alone. Two weeks after changing we slaughtered some which had lost 4.1 pounds per day. There were some on alfalfa that gained back a little. One third were held on alfalfa throughout that gained 1.25 pounds per day. There were no differences in tenderness against marbling and we found very low correlations. These were young animals. In older animals there might be some difference.

The campus is expanding and part of the beef area was taken over for dormitories. We have another farm and I believe we will be able to expand our numbers a little. We will have to replace our buildings and there will be some interruption during the move.

We do hope to get into some line testing. We have a Shorthorn line we think is performing well under our conditions and would like to carry them on in a line test with others.

Our ROP program in the state has moved along fairly well. We have about 1,000 animals on test in the state. I am afraid, however, the main interest is in promotion rather than cattle improvement. I don't know how to regulate that to get improvement. But at least they are developing some interest.

Shorthorn carcasses rank very well with Hereford. In tenderness they are right along with Herefords, but on fat, it is not as well distributed. Marbling is good, rib eye area a little better.

Washington--Dr. C. C. O'Mary

We have been short of help. We have made one change in our project. Since we have acquired some additional land we have decided to increase the Angus herd to cover the entire project, which will give us much better control than comparing Hereford, Shorthorn, and Angus. We plan to have 40 cows in the closed herd and 20 in the open herd.

In slaughter of a few of our steers that have been on all-pelleted ration we have seen this increased thickness in the rumen wall.

We knew animals bedded in straw were consuming this and last year made a change and bedded with shavings, and some of the cattle began to eat shavings. We had quite a serious bloat problem and in the Angus herd have considerable bloat. We added straw to the bedding to cut this down. I hope we can learn to live with and eliminate this threat within the herd.

We are in the process of trying to put our data on cards, going back in the records since the project started.

Dr. Stonaker: Is it possible that you could tie your bloat work in with Dyer?

Dr. O'Mary: He is now using some of our bloating cattle.

Dr. Kieffer: What has become of Dyer's work with crooked cattle?

Dr. O'Mary: He is still working on it. His work is with manganese, but there is work with lead, also.

Wyoming--Dr. George E. Nelms

Regarding freezing semen from young bulls, there is some difficulty in evaluating semen regarding its ability to withstand freezing. I am not sure whether semen from young bulls is different from semen of older bulls. At any rate, the method for evaluating semen from bulls doesn't seem to work with the young bull semen. Frozen semen evaluated as satisfactory, some used will settle cows and some won't. Conception is very erratic. We are going to have to wait until the bulls are a little older before frozen semen is satisfactory. I plan to freeze some at 16 to 18 months. A better quality of semen should be obtained.

Last year we were slaughtering Angus bull calves at monthly intervals. We started at about 100 days of age, slaughtered three calves at each interval. What we planned was to establish a base line on muscle development. The literature is very scanty. How does a 1,000 pound animal at twelve months of age compare with an animal of 24 months of age? This is with Angus bull calves. It doesn't apply to steers or other breeds. The data are preliminary (tables in the report).

Project Revisions and Reviews

Arizona--Dr. O. F. Pahnish

Line 1 and Line 9 breeding have something to offer, Lines 6 and 10 not so much so far as top crosses are concerned. But information on top cross females shows advantage of Line 6 females everywhere.

In the proposed project part of the herd would be used as in the past for some continued top crossing studies with stock from any promising source, initially from top cross Line 6 bulls to get backcross progeny backcrossed on San Carlos stuff. By backcrossing again on San Carlos stuff we might have a better opportunity to maintain type. That may not accomplish a great deal, but we do have enough stock that we can continue with the program.

Regarding table 2, what we hoped to get was information on various top crosses with reasonably good sized subclasses.

We have hopes of continuing for a period of two years, using two top cross bulls carrying the Miles City breeding each year.

Table 3--there is a question whether it should be continued as listed. We will have three years' data accumulated without this.

Dr. Bogart: I move that Dr. Pahnish circularize the revision as soon as he gets it ready and we can act upon it by mail so he can have it for the 1963 breeding season.

Dr. Stonaker: I second the motion.

Motion carried.

California--Dr. P. W. Gregory

We have revised both of our projects. They have been submitted for acceptance by the Committee. I move that both of these projects be accepted.

Dr. Bogart: I second the motion.

Motion carried.

Colorado--Dr. H. H. Stonaker

We should revise our project. There are two things we are doing differently. We have increased numbers at Fort Lewis slightly. We hoped to bring in two of the top line-cross bulls and make matings against the replacement inbred bull from those lines. I am wondering if it is worthwhile incorporating into a project change.

We are contemplating a move from one-sire to two-sire lines in Brae Arden, San Juan, and Royal. We might try to increase those lines to two-sire lines and fall within the lines of our present objective. Do we need to revise the project to incorporate those into the project?

Dr. Bogart: I think those are procedural. I move we leave it up to the Colorado station whether the project is to be revised.

Dr. Brinks: For how long?

Dr. Stonaker: For three years.

Dr. Bennett: I second the motion.

Motion carried.

(Dr. Stonaker is to circularize any points of revision within the next year, and this is to be discussed again in 1963).

Idaho--Dr. R. E. Christian

As of September 1, we will have an Experiment Station statistician which will give us a tremendous boost in the analysis of data from this particular project.

Dr. Nelms: I assume your project outline as written is based on present livestock.

Dr. Christian: Yes.

Dr. Clark: Will you be taking these eight to ten offspring--on page 7--how will these steer offspring be selected?

Dr. Christian: As much as possible, random sample of the steer offspring available. One question that has bothered me is the method of selecting pairs of bulls to be leased to cooperators. In the case of the cooperators we have, they will take any bulls we give to them. There has been no indication that one cooperator wants two top bulls, etc. They are willing to take what we send, switch bulls as we want to, etc. But should we select two bulls alike, two different, or random? Which approach would be best?

Dr. Nelms: On what basis are you going to pick the best bull?

Dr. Christian: Bulls that come off performance test. Weight is an index. This should be on the basis of a subjective decision as to the best bull.

Dr. Bogart: It is difficult without an index.

Dr. Christian: It is possible we would index them. That might be a procedure we would add.

Dr. Cobb: Might it not be better to stick to one trait?

Dr. Christian: Just exactly which trait would you select?

Dr. Brinks: If you want heritabilities of all traits you would have to pick bulls at random.

Dr. Christian: That is what I thought. We should pick pairs of bulls at random, which would make it unnecessary to index them.

Dr. Clark: If you can, I would say to make it at random.

Dr. Christian: I will put that in then, as part of the procedure. When the statistician gets there I will discuss the thing with him, also.

Dr. Bennett: I move the Idaho project be circulated by mail for final acceptance.

Dr. Gregory: I second the motion.

Motion carried.

Nevada--Dr. C. M. Bailey (review of project)

We don't plan to make any changes in the project for at least two years, but right now what we have describing our work is not exactly what we are doing. The project was started in 1949 and continued until 1954. It was a study of growth and performance testing. In 1954 a change was made to a genetic-environmental type of study. There were to be grade lines at Knoll Creek and purebreds at Reno. In 1955 it was decided to use purebreds throughout at both locations, so that is what was done. The present project was started in 1955 when random females were assigned to five lines in two environments.

Reno--rate of gain, economy of gain, and conformation lines
Knoll Creek--rate of gain and economy of gain lines

Our purebred foundation animals were obtained from five or six different Hereford breeders in the State of Nevada.

The objectives were to find the effect of environment on traits of economic importance.

Objective 1. To determine the effect of environment on effectiveness of selection for several traits of economic importance in range beef cattle

This is still very appropriate.

Objective 2. To determine and evaluate the genetic-environmental interaction between area and method of production and several traits of economic importance in range beef cattle

This is still appropriate.

Objective 3. To determine the relative importance of rate of gain, economy of gain, and a selection index based on overall merit as selection criteria for range beef cattle

a. Additional criteria will be developed and studied

b. Measures of "efficiency of food utilization" will be studied. Attempts to develop more satisfactory measures will be made

The conformation line is being carried on instead of the selection index line. Parts a., b., and c. are being carried out in part.

Objective 4. To determine the effect of reproductive efficiency on selection in range cattle

a. An attempt will be made to develop a practicable early-pregnancy diagnostic method

b. The relation between time or rate of maturation and fertility will be studied

c. An attempt will be made to determine and evaluate the causes of infertility in range cattle

d. An attempt will be made to develop a practicable method of synchronizing the estrous cycle in range cattle

At present not too appropriate.

Something might be mentioned as to the type of work done in this project. Dr. Kidwell published papers on growth relationship in range cattle, comparisons of individual vs. group feeding, blood glutathione in relation to growth.

Since that time we have obtained limited information from carcasses of reject bulls (these data are not analyzed). This year we analyzed data collected from the first five years of production testing from this project. In effectiveness of selection it appears we were not doing much in separating rate and economy of gain. Maybe we are not doing the best job possible in measuring feed efficiency, etc. Another conclusion that seemed to occur in selecting for rate and economy of gain, we were pretty much doing the same thing for rate and economy selection, but these two lines have separated from the conformation line.

Changes which have occurred since 1955--the farm was moved from a small farm to a 1,000 acre farm. This has changed our facilities a great deal. There has been the initiation of project W-49 on reproduction studies, which has taken over that part of this project. We have moved to a new agricultural building and have facilities for small animal colonies.

The direction of the future--continuing the genetic-environmental interaction work placing major emphasis on collecting experimental data and if we can collecting other information but getting information from our basic experiment and not tamper with that.

Continue the rat work.

De-emphasize reproduction in W-1.

Continue performance testing data and growth and development by taking semiannual weights of the cow herd and maintaining cow production records.

Carcass figures on bulls--do more than slaughter W-1 reject bulls. Do some feeding and getting a little more information.

We try to get top cross information as another check on the results of selecting in the genotype-environmental interaction work.

Using top crosses for information on genetic progress. That is a procedures problem.

We plan to switch the random range herd, selling off 60 cows. We have two square miles of fenced pasture. We can handle only about 30 cows in each pasture. We are pretty much set up with no encouragement for expanding numbers. Also, we have a limit at Reno of 90 to 100 cows. There will be no expanding, for we are running out of individual pens and cannot get enough grass hay for performance testing.

As to the data we might have in two years, if no change is made until the 1964 or 1965 breeding season we probably would have collected individual feeding data from about 1,000 calves.

Alternatives would be:

1. Maintain present lines but increase sires to two or three to cut down inbreeding

2. Another possibility, select for the same trait in rate of gain and economy of gain lines so we have two replicates in each location

3. Drop the conformation line and pool rate of gain and economy of gain line at each location, then start off by crossing lines selecting for weight for age, or something like that. (We have no conformation line in our poor environment.)

If we consider throwing out the conformation line and combining the two lines we could probably get some information on line crossing and heterosis. I think we would reduce our selection pressure and get some information of that type.

Dr. Nelms: Should the Nevada project be revised to eliminate W-39?

Dr. Bogart: I move Dr. Bailey circulate a revision in line with the current work, which can be moved on next year.

Dr. Gregory: I second the motion.

Motion carried.

New Mexico--Dr. L. A. Holland (review of project)

We would like to continue as at present until we have a chance for outside funds, then possibly submit a revision. But we would not like to have a revision at this time.

Dr. Nelms: Have you any idea of the time before changes are to be made?

Dr. Holland: Two years. We are still getting useful information under our present project and we have some pressure to change somewhat because of numbers of animals increasing. We have not discarded any animals except by culling since 1953, so right now we have 50 cows to calve. Any revision entails getting rid of some Old Line cattle. We would like to get some money to keep these animals to study the heart anomaly. I would like to keep these cows to get more production records on them. Part of our objective is to study production on a lifetime basis.

Dr. Clark: You do intend to start work soon on your cow productivity, on which you have a large body of data.

Dr. Holland: I would like it to be the pleasure of this group to let us continue as we are for another two years.

Dr. Clark: Actually, this project leader has taken a lot of old records and put them into very fine form.

Dr. Bogart: I move he be given two years under the present project outline.

Dr. Bennett: I second the motion.

Motion carried.

Oregon

Dr. Bogart presented a project revision, and a brief discussion followed.

Dr. Pahnish: I move the Oregon revision be accepted with the suggestions incorporated.

Dr. Gregory: I second the motion.

Motion carried.

REPORT OF THE OBJECTIVES SUBCOMMITTEE OF THE W-1 TECHNICAL COMMITTEE

L. A. Holland, J. A. Bennett, and Ralph Bogart, Chairman

Each technical committeeman was asked to express his views on the objectives of W-1 and to discuss these objectives with his Director to obtain his views. The general result of the reports by technical committeemen will be summarized in rather broad terms. The points of special interest from each station will then be presented. The revisions in wording that might be indicated will conclude this report.

It is generally considered that the objectives of W-1 as set forth in the latest revision are satisfactory, that work now being done at the state and federal stations are covered by the objectives, and that the Directors generally interpret the objectives in the broad way in which they were intended.

Arizona--Indicate which states are working on which objectives. Point out how contributions from the project enhance other research and how other projects contribute to the work of W-1. Emphasize interstate and interregional cooperation where it exists.

California--Bring out how other disciplines may be used to further these objectives.

Colorado--Change objective 4 and add objective 7.
4. To study individual genes, inbreeding, and heterosis and their effects on the many traits in beef cattle which lend themselves to physical, chemical, physiological and cytological analyses.
7. To further the use of cattle as a genetic laboratory animal exploiting the natural advantages of cattle twins and strains for more complete estimates of genetic components of variation and the large size of the animal as a quantity source of body tissues.

Hawaii--Carcass studies are a part of beef cattle improvement.

Idaho--No report.

Montana--Clarify objectives to include carcass studies.

Nevada--Need control populations for comparisons. Some of the areas of research needing expansion are:
1. Determination of relative importance of traits in the Western Region.

2. Development of techniques such as ultrasonics and performance testing for measuring these traits.
3. Development and testing of selection schemes.
4. Heterosis
5. Explore use of artificial insemination as means of improvement of carcass traits or for evaluation of genetic progress.

New Mexico--Some rewording might help. Carcass work needed as part of W-1.

Oregon--Director feels that objectives are satisfactory as they now are. Project is and must be broad but objectives should not be further broadened unless phases covered by some of the objectives are completed.

U. S. Range Livestock Station--Objectives are satisfactory as they stand.

Utah--Some rewording for clarity of reading is all that is needed.

Washington--Some rewording is needed. Three questions were raised:
1. Should experiment stations continue to be responsible for developing and maintaining lines or should this be the responsibility of purebred breeders?
2. Are these objectives the top priority objectives?
3. Are these the top priority problems?

Carcass work and companion small animal studies are considered as a valuable adjunct to the project.

Wyoming--More work needs to be done as a part of W-1.

Objectives

1. Satisfactory as is.

2. To develop selection methods and breeding systems which will be effective in the development and use of productive lines of beef cattle.

3. To determine the inheritance of specific genes and factor interactions.

4. Stonaker's item 4, or change to read:
To determine the genetic and physiological causes of changes in vigor, size, fertility, or other characteristics of inbred lines that have been or may be established.

5. & 6. Satisfactory as they are.

Might add objective 7 as suggested by Stonaker.

Perhaps the most needed revision is in the procedure statements which parallel the objectives. This can be done best by Dr. Clark since he has the over-all W-1 program well in mind and knows the nature of research being done at each of the stations.

DISCUSSION

Dr. Bogart: In January most of the people who reported indicated that the objectives in W-1 as set forth are satisfactory. Work now being done is covered by the objectives, and the Directors of stations have interpreted the objectives in the broad way in which they are intended.

With that in mind, it would appear that only small revisions are needed rather than major changes.

Objective 1. Satisfactory as is.

Objective 2. Might be better if it read as follows: "To develop selection methods and breeding systems which will be effective in the development and use of productive lines of beef cattle."

Objective 3. To determine the inheritance of specific genes and factor interactions.

Objective 4. Should we accept Stonaker's Objective 4, or should we accept "To determine the genetic and physiological causes of changes in vigor, size, fertility, or other characteristics of inbred lines that have been or may be established."

Objectives 5 and 6 were considered satisfactory as they are.

Should we add an Objective 7, as suggested by Stonaker?

Should we bring in more accurately which stations are working on which objective at the present time?

Perhaps the procedure statements need revision to parallel the objectives. I suggest that Dr. Clark and his co-workers make such a revision since he is the one who knows the nature of the work being done at each station.

Dr. Nelms: Is there any discussion regarding this report?

Dr. Brinks: Regarding Stonaker's Objective 7. Does it look like that might come about at one of the stations, or at Colorado? Are you thinking about it in the near future?

Dr. Stonaker: What prompted it was this situation which you all have observed. All of our stations are being driven towards NHS, NHIAC. I don't think it is the right thing, but that is the way it is. But it would seem that we might have some opportunity to siphon off support from some of these other agencies. I am convinced that we have a good laboratory animal and I believe that the funding agencies are not convinced of this. That is where we differ in our viewpoints. You might have ideas whereby cattle as laboratory animals might be used.

Dr. Nelms: Do you feel identical twins might be an approach to finding out what we are after?

Dr. Stonaker: I think not identical twins alone, but other combinations such as have been used in Edinburgh, and somewhat in this country. Someone in W-1 and elsewhere might make use of it.

It seems that to all that our project is slanted toward identification of economic strains.

Dr. Bogart: It would seem to me that this objective could be looked upon as not being a new area of work, but it might give some added prestige, some recognition, that large animals do offer a good opportunity for study.

Dr. Stonaker: Regarding cattle twins, you just don't find twins in other animals than man for studying prolapse, cancer eye, and any other thing coming up where strains, twins, and combinations would give us better estimates of parameters.

Dr. Holland: Since no one is working with twins, should it be stated "strains."

Dr. Stonaker: Twins offer possibilities that strains do not.

Dr. Bogart: It might be better if you would leave out twins and strains in cattle and stress the advantage of cattle.

Dr. Stonaker: The fact that the animal is a large animal offers opportunity.

Dr. Nelms: What is your pleasure so far as Objective 7 is concerned?

Dr. Brinks: I think it would be a tremendous idea, but use of twins might be premature since no one is using them.

Dr. Bogart: I move that the objective be stated but that we strike out "twins and strains."

Dr. O'Mary: I second the motion.

Motion carried.

Dr. Bogart: I move that the report be accepted and that the changes as indicated in the report be made using the recommendations of Dr. Stonaker for item 4 but making revisions as suggested otherwise--change 1, 2, 3, and 4, and add 7, and changes in the procedure statements to be made by Dr. Clark.

Dr. Gregory: I second the motion.

Dr. Burris: In reading the objectives it seems like Objective 1 is in a sense incidental to the research work we are doing. I don't feel particularly that the development of lines is desirable or essential in research work of this nature. What we really are interested in is methods and knowing how we got the lines if we do develop them. There is not a great deal of research or science involved in Objective 1. I would say if you want something in there on developing lines, put it as Objective 7 so it doesn't look as though that is what we primarily are doing.

Dr. Nelms: As much as artificial insemination is being used in the beef cattle industry, I don't see why this couldn't be accomplished.

Dr. Bogart: This was the objective the Washington director was most concerned about, whether we should be developing lines, or whether the breeders should. I have interpreted it that we are trying to develop concepts in the development of these lines and the use of them, and also we have to have certain described populations to do other work with. I don't think we could do it without our described populations.

Dr. Burris: With the farmer and industry that is what you would have to work with, not described populations.

Dr. Bogart: But for us to know what we have we must be more accurate than the farmers.

Dr. Gregory: I don't think we can depend on the farmers and producers for what we need. Producers switch back and forth. They don't follow a consistent pattern.

Professor Flower: I agree with Dr. Burris, the objective is not the development of lines, it is the development of methods for developing lines, and I too agree that there is not going to be anything good come out of this. Among beef cattle geneticists of the nation there are going to be some very significant contributions in the future. I think the objective should be changed to "development of methods of producing superior lines."

Dr. Stonaker: How are methods different from what already has been accepted for laboratory species? It seems to me that no one of us is at a station where materials or project are comprehensive enough to test one system of mating against another. But the economic importance of beef cattle in the country has forced experiment stations to apply within the limited area they can the methods they think might be effective, but we don't have a very critical set of results for comparing methods of selection with mild inbreeding vs. intense inbreeding vs. mild selection vs. intense systems. I think we are not going to have very critical means of appraising that. We certainly don't have to date. I wonder how critical we can be with methods. We didn't start any of our work with common genetic sources and there is no opportunity to combine methods.

Dr. Burris: That is our shortcoming.

Dr. Bogart: On this matter of developing methods, about the only thing we could do would be weigh whether the methods that are in

use have been developed by laboratory animals where they have a multiparous reproduction and will apply to large animals that are monoparous. Otherwise we would be away ahead in using laboratory animals.

Dr. Gregory: All of our basic knowledge has come from laboratory organisms whether animal or plants. But if we are to know something about a particular species such as cattle we will have to study cattle. We can learn fundamental principles, but all of the problems that may be applicable to these small animals may not exactly coincide with what is involved in cattle. So, we will have to study cattle if we are going to find out just where we are going. Small animals will help.

Dr. Burris: It is necessary to obtain this genetic information. With the project as it is we can demonstrate we can make progress, but how much progress itself in comparison with environmental improvement.

Dr. Stonaker: If we had some kind of base against which Miles City herds are trying to operate, we might be able seriously to meet the objectives.

Dr. Brinks: We just need controls. I agree one hundred percent.

Dr. Gregory: What is a control?

Mr. Flower: The overlapping genes used by poultry people is a good approach.

Dr. Clark: Our repeat matings at Miles City while not designed specifically for that purpose have been of interest. Lush said that was one method we could utilize but we are not too pleased about that as a means of measuring actual genetic improvement.

Dr. Nelms: No one doubts that we need controls, but what is an adequate control?

Dr. Harvey: The cattle breeding experimenter is not willing to sacrifice animals to get controls. It has to be outlined in the project.

Dr. Stonaker: I got the inference that we could depend on control populations.

Dr. Warwick: I don't think the idea of repeat mating is antagonistic toward doing research. It is a mechanics that is designed into the project.

Dr. Bogart: But is is going to take about 40 percent of the animals when the project is outlined.

Dr. Harvey: It takes a percentage of the animals designed into the project. That percentage depends on what you want to contribute.

Dr. Bogart: With a 15-cow line, that would be three cows for controls and they wouldn't tell you anything.

Dr. Harvey: Then have an outside control.

Dr. Clark: Are you satisfied with what the poultry people have done in this field of controls?

Dr. Harvey: The difficulty is that a control being brought in each year is not necessarily the same.

Dr. Stonaker: Could we participate in a common pool of cattle handled in some sort of systematic manner? Could we do as Nevada did randomizing populations with some kind of systematic rotation of bull calves among stations--Nelms keep 10, I would keep 20, Miles City 75 to 00. But we would have a common cattle pool with some at each station. Maybe we can't say there is no genetic drift, but we would have some kind of appreciation.

Dr. Harvey: I think numbers would be prohibitive to make it accurate. I think 1,000 head of cattle would be involved.

Dr. Bailey: Those cows are producing calves. Why would it be so expensive?

Dr. Harvey: Repeat mating if designed properly will adequately fit the requirement.

Dr. Kieffer: How valuable is storing semen over a long period of time if it can be done, then bringing it back and comparing the offspring with the contemporary animals? If it can be stored for a long time that is one way we can have genetic control.

Dr. Bogart: I think we are talking procedures now more than objectives. Controls are a valuable thing but is not our objective

the subject under discussion? We might agree to put Objective 1 at a lower ranking than it now has--perhaps last. And I would be inclined to agree with Burris in saying instead of "develop inbred lines" say "develop concepts regarding inbred lines and their use." Object 2 would move up to first place.

Dr. Gregory: I second the motion that we accept the report of the Objectives Study Committee with the changes outlined.

Motion carried.

Dr. Bogart: No priority is implied in the order of the objectives.

Dr. Burris: Is it implied that the project will be revised?

Dr. Bogart: To the extent of incorporating the changes discussed.

Report on Regional Publication

R. T. Clark

The matter of the regional publication was referred to by our Administrative Adviser. It is our present intention to approach the reports you have submitted as the framework around which we will develop a publication. It is our intention to compile a publication that will be quite different from those of the other regions. We will build this on the list of material that has come from W-1 since its inception.

The total as of today of our publications prepared by the cooperating agencies and states is 035 since we started W-1.

You will recall a few years back various project leaders accepted responsibility in a few defined areas of work. We put together a ten-year summary which the Chairman advanced to the Committee of Nine in the fall of 1959. However, it was not in a form acceptable as a regional publication. Our intention is to put this in presentable form as rapidly as possible. I have set up no time schedule on this. I should hope within the fiscal year it would be completed.

We were pleased with the way our Administrative Adviser handled arrangements for the publishing. To pull the material together is not going to be an easy task, however.

We have made some division of responsibilities. The various sections will be handled

Pahnish	Inherited abnormals
Clark and Brinks	Inbreeding and line development, including lines we have developed so far
Bogart	Factors influencing production traits
Roubicek	Carcass evaluation
Bennett	Production testing
Brinks and Clark	Type studies, conformation scores, and body measurements
Christian	Physiology of reproduction

The publication will end with a listing of publications issued so far from W-1.

Dr. Bogart: Relative to the Regional Publication, would you indicate some of the mechanics of it? Maybe Dr. Wheeler would be the one to comment on it?

Dr. Wheeler: Director Price of the Oregon station agreed to cover the publication price covered by firm orders from the stations. This is common procedure. The clue to the whole thing rests, naturally, on the number of firm orders at a satisfactory fixed price determined by the Oregon station. There is no question Oregon will do this, once the manuscript is in their hands. I also feel rather certain there will be sufficient orders from the other stations and individuals to cover the cost of publication. This will be the procedure, and we are assured this can be done. I think it is very fine that Director Price will do this. We are ready to go once the manuscript is ready for editorial treatment. The Oregon editor will do the editorial work.

Dr. Holland: What type of publication do you have in mind? The number of copies we order will depend on this.

Dr. Clark: Our intention basically in the beginning was to report the findings in the same terms as the authors had presented them, actually reporting in summary form the original presentation.

Dr. Holland: Will it be in terms where our ranchers can understand it? We might want ten copies if it is technical, 500 if it is so the ranchers can understand it.

Dr. Clark: We had expected to present it slanted more to the technical side.

Dr. Wheeler: I think Holland has raised a real question. When this material is in the hands of the Oregon editor we are going to have to come to grips with the Committee as to the orientation of the publication. The editor has to know the nature of the publication. With that in mind, he can do the type of editorial work that is extremely helpful.

The real problem is how to put this material in the context or in the form that we feel is the type of information or the nature of publication it should be. Of course my views I have expressed many times to this Committee. I feel a publication of this type should have wide reader appeal at the layman's level as well as the technical level. We are doing research funded by tax funds and our objectives

are to the benefit of the cattle industry. I feel rather strongly that ultimately we must have some type of framework that can be understood by the ranchers and farmers. It should not be strictly technical. If so, we are going to miss the mark.

Dr. Cobb: We should call on Dr. Warwick for experiences they have had in the other regions.

Dr. Warwick: I believe the S-10 publication is satisfactory in this regard, judging from some of the comments and a report from one station. NC-1 asked if they could buy copies of this for distribution. It is reasonably technical, to be sure, and it brings together a lot of information, but it also is reasonably readable by the farmer or rancher. There is a possibility of creating this W-1 publication somewhat in the same vein. Don't make it Farm Journal style. Keep the quotes in it, but make it readable for the rancher and farmer. I am interested in how well you think this S-10 publication met that objective.

Dr. Wheeler: It is fine, I think, to show how you arrive at or derive your material. I would not want to distribute the derivations, the statistical formulas, etc., in the body of the publication but refer to that as a supplement or addenda for those who wish to know. I think Dr. Holland is right, if you put this in the publication you have a tendency to throw your reader off balance. At the same time you can include this as a part of the publication and in no way reduce the publication in usefulness for people in the field.

Dr. Bogart: The general thinking of the Oregon station was that we would try to write this in lay terminology, keeping all scientific aspects in and leaving all the highly technical material and especially language out, but not taking the attitude that we were writing for a sixth-grade education level but writing to top rancher and Extension personnel, etc. That was the attitude of the Oregon station.

Dr. Clark: Here is the great difficulty that we are conscious of--we don't want to put our own interpretation on the material that you yourselves have interpreted and presented in the literature. It is a little ticklish to handle things in this way. We don't want to take your studies and present what we think you have. We don't want to do that. I don't want this to take away from what the investigator has already presented in making the presentation. I don't think you need to be concerned. We are going to take a whack at it and see what comes up.

Dr. Holland: We would visualize this as something to pass out to rancher groups. We have twenty or twenty-five who would wade through a very technical publication, but most won't. They want to know what you think, but they are not going to wade through a technical report.

Dr. Warwick: Are you going to list the publications?

Dr. Clark: The material we reviewed we would list.

Dr. Warwick: Not these 835?

Dr. Bogart: No, not all.

Dr. Clark: The publications we would list at the close would be the ones we had used in the body of the text.

Dr. Bogart: I think, also, things like theses and some of the popular articles would not be reviewed.

Dr. Stonaker: I differ about theses.

Dr. Bogart: If it has been published, but not if we would not have it available for anyone who wanted a copy. The idea of using a theses as a reference would not be done if it is not available.

I wish you people would check through your files for photographs that might fit in with the material I am helping to review for the regional publication. I think that would be true for all the people. If you have some good photographs send them to the person handling the material in the category concerned.

Literature Review

R. T. Clark

Carl Roubicek has put together a revision of the Literature Review. We have gone over it. We have a complete copy of it. It covers 2,800 references which Roubicek has done within the past year, with the full approval of the University of Arizona. He has done an excellent job of bringing together the literature in the field in which we are primarily interested.

It is the intention of the University of Arizona to try to obtain a private grant to handle the printing of 5,000 copies of the Literature Review presented in a very desirable form--a real printing job. This time we expect to make provision for annual or biennial supplements, and that is one of the jobs Carl is particularly competent in. I have never known in all of my experiences anyone else who is so good in handling himself within a library, in handling the literature in an area of research. We have no question that this Literature Review will receive as excellent response as the first one. There is no question of the time saved workers by that first review.

Statistical Services

James S. Brinks

In Denver we have a number of Federal agencies with IBM equipment and we have working agreements with two of them--the Air Force Accounting and Finance Center and the Rocky Mountain Arsenal. For our big analyses we have use of a IBM 7090 at the Bureau of Standards in Boulder. The primary thing we have been working on is the Miles City data, and we also have worked with a few of the stations--New Mexico, Oregon, Nevada. We have helped these stations quite a lot and certainly want to help anyone else who would like to do this. Many of you have your own machines, but where equipment is not available or personnel is a problem, we would like to help out in any way we could.

Dr. Bogart: I would like to encourage all of the people to avail themselves of tieing in with Dr. Brinks for analysis. I would certainly recommend that cooperation very highly.

Dr. Cobb: I would suggest that everyone check with Dr. Brinks on the design of experiments. That is where we fall down. If an experiment is designed wrong the analysis is hard to come by.

Biometrical Services

Walter R. Harvey

I want to explain our position in Biometrical Services. We are a part of ARS. We work cooperatively with all research and control divisions of ARS. We have several stations. I am a member of the

Livestock Staff. Our primary responsibilities are in consulting and providing facilities through ARS. This is done on a strictly cooperative basis and we are glad to help anyone who comes to us for advice and counsel with respect to all experiments and analysis of data.

Business Meeting

The meeting was called to order at 1:00 P.M., July 13, with Dr. George Nelms presiding.

Since Dr. Warwick, Dr. Burris, and Dr. Harvey left the meeting early in order to catch planes out of Denver, Dr. Wheeler was the first speaker. He presented a tabulation of the allotments for 1962-63 as approved by the Western Directors at the March meeting.

1962-63 Allocations to Regional Project W-1

State	1961-62 Allotment	1962-63 No. increase	1962-63 $1 M increase
Arizona	$4,000	$4,200	$4,400
California	5,300	5,500	5,700
Colorado	8,300	8,500	8,600
Hawaii	4,100	4,300	4,500
Idaho	5,300	5,500	5,700
Montana	6,600	6,800	7,100
Nevada	5,400	5,600	5,800
New Mexico	8,300	8,500	8,600
Oregon	8,300	8,500	8,600
Utah	6,600	6,800	7,000
Washington	5,600	5,800	6,000
Wyoming	7,100	7,300	7,500
P & C	2,300	2,300	2,500
Total	$77,200	$79,600	$82,000

The Regional Research Committee and the Western Directors had acted to restore previous cuts in allotments to states, so as a result each state will have a small increase for 1962-63 irrespective of whether the allocation to the states is increased by the $1 million. It is not known whether the $1 million figure is realistic. If it stands up there will be further increases of small magnitude.

The W-1 allotment has become rather fixed over the years. The project is, historically, the longest in duration and the one funded at the highest level. Also, it has the largest number of participating stations. But is difficult to develop a great deal of enthusiasm on the part of the Directors to increase the allotment substantially. It is hoped that Congress will see fit to come up with an appropriation which will provide for a further increase.

The Technical Committee is at liberty to review the state allotments and recommend to the Administrative Adviser different levels of support. Also, Committee suggestions regarding use of P & C residues are welcome. In the absence of recommendations from the Committee, these matters will be handled as they have in the past.

Dr. Wheeler closed with a plea to expedite the Regional Publication as it will be an outstanding contribution and many people are waiting for it.

Dr. Nelms then called on Dr. Robert S. Temple, Regional Coordinator of S-10, who attended the previous sessions. Dr. Temple gave a brief resume of the S-10 Regional Research Project and some contemplated changes. A regional approach has been adopted on some research ideas. The Coordinator will review the results and prepare a publication about once a year. One of the problems to be studied is fertility, and another is going into the field with the sonar device, the machine to be used being a Branson Sonaray which has been acquired by ARS for use in the Southern Region.

Dr. Nelms was confirmed as Chairman of the W-1 Technical Committee for the ensuing year.

Possible locations and dates for the 1963 meeting were discussed. Motions were made and seconded that the W-1 Technical Committee meet in Logan, Utah on August 19 and 20, 1963. Motions carried.

Dr. Bennett presented a resolution which he moved be adopted, which motion was seconded by Dr. Bogart and carried unanimously.

> BE IT RESOLVED, that the W-1 Technical Committee express to the Regional Coordinator, Dr. R. T. Clark, their pleasure in having him return to active duty with the group, and extend our best wishes for a complete and speedy recovery. Furthermore, the W-1 Committee takes this occasion to express sincere appreciation for the high quality of research he has encouraged, stimulated, and promoted throughout the period of his tenure. Through his help and the efforts of the contributing stations, the W-1 program has yielded much knowledge in specific fields in animal science and also has made definite contributions to scientific principles in many of the basic disciplines and gives promise of being even more productive in the future.

Dr. Gregory then moved that the Chairman be instructed to send a copy of the resolution to each of the Western Directors and to each person in Agricultural Research Service and Cooperative State Experiment Stations Service directly interested in W-1. Dr. Bogart seconded the motion, which also carried unanimously.

Dr. Nelms thanked Dr. Stonaker and Colorado State University for the hospitality shown the W-1 Technical Committee members.

Motion was made and seconded that the meeting adjourn. Motion carried.

Meeting Adjourned